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THE
SCIENTIFIC AMERICAN CYCLOPEDIA
of
FORMULAS

PARTLY BASED UPON THE
TWENTY-EIGHTH EDITION
OF
SCIENTIFIC AMERICAN CYCLOPEDIA
OF RECEIPTS, NOTES AND QUERIES

EDITED BY
ALBERT A. HOPKINS
QUERY EDITOR OF THE "SCIENTIFIC AMERICAN"

Volume I

15,000 FORMULAS

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PREFACE

FOR more than seventy-five years the SCIENTIFIC AMERICAN has annually given its readers the experience of practical experimenters in every branch of the useful arts, all over the world. Some thirty years ago the Editor of the present volume spent about two years in collecting and garnering formulas and other items of information. The result was the "Scientific American Cyclopedia of Receipts, Notes and Queries." It at once became the standard authority among English-speaking peoples, and notwithstanding the fact that it has had many imitators it is still recognized as the most reliable compilation ever published devoted to formulas. The world, however, has rapidly advanced. Each year a vast amount of technical literature accumulated. Instead of attempting to make any drastic revision, it was therefore deemed wise to recompile and rewrite the entire book. This work required the constant attention of a staff of experts and professional indexers for a period of two years. The old book was not thrown out in its entirety, possibly some thirty per cent. of the formulas were retained. The remainder, however, is entirely from new sources, the chief of which is the SCIENTIFIC AMERICAN, after which come the American and Foreign drug and technical journals. Concerning the question of credit, it may be stated that practically all the drug and technical journals of the world have been laid under contribution. A special list of sources credited is published elsewhere. The mass of material which has been handled is enormous; over 150,000 formulas were rejected owing to lack of space. When it is considered that the present volume contains only 15,000 formulas, it will be seen that one in ten has been selected. From this it will be noted that the present work has been compiled with much more care than any similar book. The Editor wishes to express his appreciation of the services of Miss Julia E. Elliott, who has been largely responsible for the classification and indexing of the almost appalling number of formulas. It has required infinite patience in sifting and comparing. To Mr. A. R. Bond, formerly of the Editorial Staff of the SCIENTIFIC

AMERICAN thanks are due for assistance in the preparation of the chapter on "Alloys." Messrs. Stillwell & Gladding have freely opened their technical laboratory for sketches. Mr. Thomas J. Keenan, formerly Editor of the "American Druggist," has kindly looked over the sections on "Poisons" and "Chemical Manipulation."

Edition after edition have followed one another and there has been little complaint of the formulas. Revision has been carried at each successive reprinting.

In closing, it is hoped that this mine of information, which is by far the most ambitious and extensive ever published, will prove of even more value than its predecessor.

ALBERT A. HOPKINS

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British Journal of Photography
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Chemical Trade Journal
Chemiker Zeitung Repertorium
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Journal of the Franklin Institute
Journal of Gas and Sanitary Engineering
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Journal Suisse d'Horlogerie
Keramische Rundschau
La France Horlogère
La Nature
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La Vie Scientifique
Lack und Farben Industrie
Ladies' Home Journal
Legierungen, Die
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Meyer Bros. Druggist
Mineral Water Trade Review
Mining and Scientific Press
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Monatschr. für Dermatologie
Montreal Pharmaceutical Journal
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National Builder
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Neueste Erfindungen und Erfahrungen
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Oils, Colors and Drysalteries
Omaha Druggist
Paper Digest
Papier-Zeitung
Parfumer, Der
Pharmaceutische Zeitung
Pharmaceutische Centralhalle
Pharmaceutical Era
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Pharmaceutical Journal and Pharmacist
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Photographic Annual
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Popular Science News
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Revue Chronométrique
Revue de la Droguerie
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Revue Industrielle
Revue Photographique
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Science Pratique
Science Record
Scientific American
Scientific American Supplement
Seifenfabrikant, Der
Seifensieder Zeitung
Shoe and Leather Facts
Soda Dispenser
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Southern Dental Journal
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Wiener Gewerbe Zeitung
Wiener Siefensieder Zeitung
Workshop Receipts
Zeitschrift für die Gesammte Kohlensäure Industrie
Zeitschrift für Offentliche Chemie
Ztsch. Oest. Ap. Ver.

INTRODUCTION

ALTHOUGH the greatest care has been exercised in the selection of the formulas and processes in the revision of the proof sheets, neither the Editor nor the Publishers can be held liable for any inaccuracies or errors, nor do they assume liability for accidents, damages, or injuries resulting from the compounding or use of the formulas. It is believed that the errors in the text are neither numerous nor of serious importance. It is not claimed that formulas for secret preparations which occur in this book are the original formulas in the possession of the proprietors of such preparations, and great care should be taken to avoid the infringement of vested rights. The "Food and Drugs Act," or what is commonly known as the "Pure Food Law," cannot be stated authoritatively in a book of this kind, as it is a question of interpretation by the Department of Agriculture, Washington, D. C., to which Department all requests for information relative to the law should be directed. The information which will be given will largely be in the form of answers to categorical questions.

True medical formulas and cooking receipts are not germane to a technical book of formulas: they have, therefore, been omitted.

Of course, it would be advisable if only tested formulas could be included, but this is absolutely prohibitive in a book of this size, and it is questionable if a work of this kind would be a commercial possibility, the price would certainly be very prohibitive, and it is quite within the possibilities that the interval of time which must elapse between the beginning of a book of this nature and its fulfillment would result in many of the formulas becoming useless in the period.

The light in which a formula should be viewed is that it is more or less of an approximation to the ideal formula, and that it should be used as a basis of experiment, each individual case requiring more or less modification. The product should not be compared with the articles manufactured by well-known makers on a large scale. Their own secret formula has probably cost thousands of dollars and years of careful experimenting on the part of their experts and chemists.

One question which presents itself in the selection of formulas is that the number of individual formulas devoted to one special thing is apt to be enormous. There is, however, a very good reason for this. For example, a manufacturer may wish to make a certain perfume which we will call "X," and he is desirous of producing the cheapest possible synthetic perfume intended to be sold in a five and ten cent store: this results in one type of formula. The next maker wishes a fair grade formula calling for both synthetic preparations and also a certain admixture of the real essential oil obtained by *enfleurage* and distillation. A third manufacturer wishes a very high grade perfume and is willing to use the most expensive essential oils in its production. Still another manufacturer wishes to make the same perfume, only he requires the addition of musk, to give permanency. Thus we have a concrete example of four types of formulas, all of which are intended for a different class of trade, and require four distinct classes of formulas. It must not be thought for a moment that the Editor used everything he could lay his hands on. The intention is never to duplicate where it is possible to avoid it, but to show all types, always bearing in mind that tests are apt to differ, and that prices change with the qualities. The aim has been to produce a book of universal application which will prove of value in every laboratory, factory, office, and home. Another reason for a plurality of formulas is that very often the ingredients called for in one formula are not always obtainable, especially in a small town. This is an added reason for seeming liberality in the printing of formulas. Enough explanation, however, is given to prevent any confusion in the use of the formulas.

The chapter on chemical, pharmaceutical, and technical manipulation has been prepared with the co-operation of well-known technical and commercial chemists. The information given is eminently practical, and a careful study of it will go far toward economy both of money and time. Amateurs are apt to waste both if not properly guided. Specific instructions are not possible in a work dealing with thousands of formulas. The best advice which can be given is to always experiment on a small scale, the smaller the better. It should also be remembered at the time of making articles like shoe-blacking, soaps, perfumes, etc., that the experimenter is at first at a great disadvantage, as he cannot obtain raw materials at as low prices as the large manufacturers, there is lack of special plant, and, above all, experience. These handicaps can only be obviated by an expenditure of time and money.

INTRODUCTION

It is believed that the new arrangement into chapters will prove of the greatest possible benefit. Thus, instead of dividing up the one class of materials such as adhesive substances, we have one heading for cements, glues, pastes, mucilages, and other adhesive preparations. This plan tends to bring related subjects, between which the line of demarkation is never very clear, into harmony and order. This has resulted in some chapters of exceptional merit which really form a whole treatise on the subject,—such as alloys, glass, leather, artists' materials, writing materials, etc.

The reader is strongly urged to never look up a subject without a perusal of the Index, which has been made with special care and is the key to the whole work. The arrangement under the various chapters is a common-sense subject-grouping which has been evolved after an experience of twenty years in aiding the experiments of over a hundred thousand inquirers. Still, the book may be used without undue reference to this classification by a proper use of the Index.

CHAPTER I

ACCIDENTS AND EMERGENCIES

No book of Receipts would be deemed complete without its chapter on accidents and emergencies. The following short resume of what should be done in case of unusual and serious accidents, is compiled from a valuable little series of books which are now out of print, which were issued in 1905 by the Mutual Life Insurance Company of New York City, and copywrighted by that company in 1903, 1904, and 1905. Republished by permission:

An accident usually assembles a crowd around the victim. The first thing to be done is to get the people away from the injured person. A space of at least ten feet on every side should be kept wholly free from everybody except the one or two who are in charge of the operations for relief. If others are needed to assist in some special duty, as lifting, removing the dress, etc., they can be specially selected from the crowd for the moment and then dismissed. The kindest thing a bystander can do is to insist upon a free space around the injured person, and to select from the crowd those who will hold themselves in readiness to start for whatever the physician or the individual in charge of the case may require.

If the person has been thrown from a carriage, injured by a blow, a fall from a height, or in some similar manner, while there may be no evidence of fracture or other *external* injury, the nervous system has received what is called a "shock," manifesting itself in faintness or complete unconsciousness.

A person suffering with such symptoms should be placed flat on his back, and the limbs at the same time straightened out, if practicable, so that the heart, which is already depressed in action, may act at as little disadvantage as possible. The cravat, collar and everything else calculated to impede the circulation toward the head or the movements of the chest should be loosened or removed. If the injury is slight, reaction will soon take place after giving the patient a sip of cold water, brandy (a teaspoonful in a tablespoonful of cold water), or aromatic spirits of ammonia (twenty drops in a teaspoonful of cold water), repeated in a few minutes. Gentle friction to the extremities, a few drops of cologne-water on a handkerchief to the nostrils, hot flannels applied to the limbs and epigastrium (pit of the stomach), are likewise useful is assisting reaction.

By this time, should a surgeon have arrived, he will examine and decide upon the special nature of the injury, and inaugurate measures of special relief. If he has not appeared, and it is thought best to remove the patient to the hospital or his home, a stretcher should be procured, or a substitute in the shape of a settee or shutter. Upon this the injured person should be gently placed, the body being supported as much as possible along its length, and the face covered so as to prevent, as far as practicable, the uncomfortable feeling of being stared at by passers-by. Four persons of unifrom gait should then gently lift the stretcher and slowly carry the person to his destination. In most cities appliances for carrying injured persons are kept at the station-house, and can be obtained on application, as well as the services of a good policeman. The latter is almost invaluable in keeping away the crowd while conveying the person through the streets. If the patient is to be taken to the hospital, a dispatch from a police-station would secure, free of charge, an ambulance with competent attendants.

Directions for the treatment of fractures and dislocations are given elsewhere.

Asphyxia.

This word commonly signifies an absence of respiration. It states a condition, but not the cause, and indicates suspended animation, produced by the non-conversion of the venous blood in the lungs into arterial. The supply of good air to the lungs being cut off by some cause, the necessary purification at that point no longer takes place, and death of the entire body ensues from the absence of arterial blood.

There are several varieties of asphyxia: (1) Asphyxia from submersion in water or other fluids, as in ordinary drowning; (2) asphyxia from mechanical causes, as by strangulation or hanging, or from foreign bodies in the windpipe or its approaches; (3) asphyxia by inhalation of gases, known as suffocation; (4) asphyxia from torpor of the medulla oblongata (an important portion of the brain at the junction of the spinal cord and what is called the brain) produced by the introduction into the blood of certain poisons.

For treatment see the specific cause of asphyxiation.

Burns and Scalds

When the clothing catches fire, throw the person on the floor or ground, so that the flames will not rise toward the mouth and nostrils. Then without a moment's delay roll the person on the carpet, or, if possible, in a hearth-rug, so as to stifle the flames. If no rug can be had, use your coat. *Keep the flame as much as possible from the face, so as to prevent the entrance of the hot air into the lungs.* This can be done by beginning at the neck and shoulders with the wrapping.

If the burn or scald involves considerable surface, symptoms of shock, varying from mere weakness to utter prostration, appear. This requires immediate attention, and a few drops of aromatic spirits of ammonia in water or a little brandy should be given, and repeated in a few moments until the return of strength is apparent. A burn, superficial as far as depth is concerned but covering a large surface, especially in the case of small children and aged people, is usually considered more serious than a burn smaller in extent but deeper and more complete. If there is reason to suppose that hot air or steam has been inhaled, no time should be lost in obtaining the opinion of a physician as to the result of the injury to the throat or lungs.

Treatment.—The burned surface should be cleansed carefully by allowing water to trickle over it. The skin over a blister should not be cut off, but should be snipped with scissors near the edge, and the water gently squeezed out. This allows the skin to remain as a protective. If the blister re-forms, it may be necessary to repeat this operation.

If the burn or scald is slight in character, one of the best applications is the cold-water dressing, keeping the linens used constantly wet.

In more severe cases a very good application is carron oil, which is a mixture of linseed oil and limewater in equal parts. Sweet oil alone is very good. Vaseline, with a little boric acid rubbed up with it, is also very soothing. Lard and baking soda mixed will relieve pain. Wheat flour is often dusted over the burn; but this hardens with the discharges, and is of as little comfort as an application of small crusts of bread would be to the injured part. Cotton wool (carded cotton, cotton batting) is often used, but the fibers become imbedded in the discharges, and then cannot be detached without pain and disturbance of the wound. Talcum powder or fullers' earth is very useful as a drying powder after the blister has been cut or any of the skin has become detached.

If the burn or scald, particularly the latter, is superficial in character, a simple and useful dressing is the application, with a brush or a soft wisp of old muslin, of the white of egg to the injury. As soon as the first layer dries, another should be applied. A lather of soap from the shaving-cup, applied with the brush in the same way, is often followed by immediate relief. These substances protect the irritated nerves beneath from the action of the air.

If a physician has been sent for, it is better not to make any domestic applications, except cold water, to the burned parts. They may prevent his using those better adapted, and keep him from forming a correct estimate of the real extent of the injuries.

If there is much shock and depression, stimulants will be needed, such as aromatic spirits of ammonia, brandy or whiskey. If there is much pain, laudanum can be given, five drops every two or three hours, until four or five doses have been administered.

Burns by Acid.—Sulphuric Acid (Oil of Vitriol), Nitric Acid (Aqua Fortis), Etc.

As alkalies destroy the living tissues with which they come in contact, so will acids of sufficient concentration. In such cases application of water will dilute them beyond their capacity to injure. Alkalies neutralize acids, and cooking soda, washing soda or saleratus can be used for this purpose. Common earth, gathered almost anywhere, applied in handfuls, usually contains alkali enough to be of value.

Burns by Lime, Caustic Potash, and Other Alkalies.

As a rule, these are troublesome, since

there is not only removal of the cuticle (superficial skin), but destruction of the soft parts below. Lime is a powerful alkali, and rapidly destroys the parts with which it comes in contact. As it is useless to attempt to pick it off, an application should at once be made of something to unite with the alkali, so as to form a comparatively harmless compound. Vinegar diluted with water, lemon juice or any other dilute acid, will answer. These things do not undo what has been done; they only prevent further mischief. The subsequent treatment is the same as for other burns. What has been said about lime is also correct for the other alkalies, potash, soda, ammonia, etc.

Ointment for Burns.—The following formulae are given by Lucas-Championniere in *Pratique de la chirurgie antiseptique*:

1.—Retinol and wax, 100 grams; oil of geranium, 15 drops; oil of thyme, 15 drops; oil of origanum, 15 drops; oil of vervain, 15 drops.

2.—Petrolatum, 100 grams; oil of geranium, 15 drops; oil of thyme, 15 drops; oil of vervain, 15 drops; oil of origanum, 15 drops; sodium naphtholate, 0.30 gram.

The author says that he has found these ointments to assist materially in the restoration of the cuticle. They are antiseptic and absolutely non-irritant.

Rice's Burn Mixture.—The formula of this preparation, which is remarkably efficacious as an application to burns, being superior to carron oil or any of the preparations ordinarily used, is as follows:

White gelatin, 7 1-3 oz.; Glycerin, 1 fl.oz.; carbolic acid, 1 fl.oz.; water, 16 fl.oz. Soak the glue in the cold water until it is soft; then heat it on a water bath until it is melted. Add the glycerin and continue heating until a firm, glossy skin begins to form on the surface of the mixture, in the intervals of stirring. Now add the carbolic acid and mix intimately.

This mixture may be kept ready prepared, and is best preserved in well-closed glass or porcelain jars. When it is wanted for use it is heated on a water bath until just melted, and applied with a soft, flat brush over the burned part, where it will form a strong, flexible skin.

Carbonic-acid Gas.

1. Asphyxia by this gas takes place as soon as the person inhales it. A sudden sense of suffocation is felt, with dizziness and inability to stand. This gas, sometimes known under the name of "choke damp," is produced in the ordinary process of fermentation and in burning or slacking lime; it is also found in mines, particularly coal mines, and in wells, cellars, or caves which have long been closed. It is considerably heavier than the atmosphere, and is consequently found lying at the bottom of the cavity where confined.

2. Symptoms: Pains, head and throat; giddiness; sleepiness, insensibility; heart and breath hurried; coma. Treatment: Fresh air; artificial respiration; ammonia *respd.*; friction; stimulants; oxygen douche; transfusion or bleeding (?).

No well, vat, old cellar, or cavern of any kind, should ever be entered without first lowering a lighted candle into the deepest point. If the flame is extinguished, or burns dimly, this indicates the presence of this gas, and no one, under any circumstances, should be permitted to enter until this foul air has been removed. It lies at the bottom, because it is too heavy to ascend. However, a strong current of common air will often dislodge it. Buckets of water dashed down into the well, or masses of lighted shavings or blazing paper, give enough movement to the air to dislodge the gas from its resting place. Freshly slacked lime also rapidly absorbs it. Then test the success of the efforts by again introducing the lighted candle, and if it burns brightly a person may enter with impunity.

Sometimes there may be no carbonic-acid gas in the cavity, and yet the efforts of the workmen may dislodge it from an adjacent space into the one in which they are breathing. This possibility should never be lost sight of.

When a person is overcome by this carbonic-acid gas he is, of course, wholly unable to help himself, and must be removed at once. Sometimes a grapnel-hook can be used with advantage, but often the better way is to lower rapidly some bold, clear-headed person, with a rope securely fastened around his middle, who can seize and bring the unfortunate individual to the surface. No time should be lost in descending or rising, as the person lowered depends upon doing everything in the time during which he can hold his breath; for, of course, should *he* inhale the gas his position in this respect would be but little better than that of the man he attempts to rescue. A large sack may be thrown over the head and shoulders of the person who descends. It contains enough air to serve for several inhalations, while the texture of the material prevents the admission of the deleterious gas to a hurtful degree.

The person suffering from asphyxia, immediately after being brought out from the gas, should be placed on his back, the neck and throat bared, and any other obstacle to breathing quickly removed. His body should then be quickly stripped, and, if he has not fallen into water on being overpowered by the gas, his head, neck and shoulders should be freely dashed with cold water. Remember, this is not "sprinkling," as commonly practiced, but a person should stand off some distance with a bowl of cold water, and *throw* its contents with as much force as possible against the parts. Other bowlfuls should follow as rapidly as possible for half a minute, while one can count thirty slowly, then the dripping water should be dried with a towel. This should be repeated from time to time, as required. Sometimes, if a brook of water is near, the stripped person might be repeatedly dipped into it, care being taken, of course, not to dip his face. Artificial respiration should be used as soon as possible.

If the person has fallen into water and become *chilled*, the use of the cold water in this manner should be avoided, as the evaporation of the moisture absorbs more heat than can be manufactured by the exhausted and overpowered system. In such a case the person should be put into a warmed bed, while hot applications and artificial respiration should be resorted to at once, as in asphyxia from drowning or hanging. While using artificial respiration, friction applied to the limbs should be kept up.

Charcoal.

Carbonic-oxide, a very poisonous gas, is given off during the burning of charcoal, and when inhaled quickly proves fatal. The person soon drops insensible, and dies of asphyxia, in much the same way as when one succumbs to carbonic-acid gas. The treatment recommended for asphyxia from carbonic-acid gas should be carried out at once.

Chilblain.

The most useful thing for these annoying symptoms is to keep away from the fire, and every night, before retiring, bathe the feet in cold water, or rub them with snow. They should then be well dried, without friction. After this, the application of the ordinary compound resin-ointment of the apothecaries is often of use in stimulating the circulation through the part. The efficiency of this ointment can be increased by adding to an ounce of it a couple of drams of oil of turpentine. It may be remarked that persons who suffer in winter from cold feet are often benefited to a surprising degree by bathing them at night, before retiring, in cold water. Such persons should always keep their feet away from the fire.

Coal Gas.

Anthracite and bituminous coal, when burned in a close room (as in the case of a kitchen shut up for the night with an open stove of burning coals), gives off, to some extent, the peculiar poisonous gas alluded to as coming from burning charcoal—carbonic-oxide—as well as other noxious gases. Persons sleeping in such a room, unless awakened as the air becomes fouled, will soon die or be found in a stupor. The treatment should be the same as described for asphyxia from inhaling carbonic-acid gas.

Contusions.

These common injuries are termed "bruises" by most people, and are the only injuries, besides wounds and fractures, produced by blows or pressure. The injury may be of the *simple* form—only a slight shaking or jarring of the texture, with no visible change except that resulting from the rupture of the blood-vessels. This is the most frequent. In the more *severe* but less frequent form, the contusion means broken blood-vessels and muscles, and tissues between and around them; the parts are thoroughly crushed, sometimes to a pulp, and damaged beyond recovery.

In contusions the first conspicuous symptom is that of shock, which generally, but not always, is proportionate to the extent of the injury. Thus a crushed finger is attended, as a rule, with much less shock than a crushed hand or foot. Contusion of certain parts, as the larger joints, breasts and other portions of the body, is followed by most severe symptoms of shock. The pain is not always as severe as might at first be thought, for the nerves may be so much injured as to be deprived of their ability to receive and transmit impressions.

The quantity of blood escaping from the ruptured vessels depends chiefly upon the size and number of the vessels injured, but in some degree upon the space in which the blood can accumulate. A single divided vessel in the scalp, owing to the looseness of the tissue in which the vessels are distributed, may permit a swelling, the result of the escape of blood, extending in area over half of one side of the head.

Discoloration is due to the color of the escaped blood, seen through the cuticle, and varies from blackness, usually indicating intense injury, through dark blue, purple and crimson, down to delicate pink, indicating only a blood-stained fluid.

Treatment.—In the milder contusions there is but little shock. When the shock is severe, place the patient on his back, head not elevated, and give stimulants as directed. The next thing is to limit the consequences likely to ensue from the ruptured blood-vessels. This is best done by elevating the part, if possible, above the heart, and applying cold, in the shape of powdered ice tied up in towels, to it and along the course of the larger vessels leading to the injury.

A common accident is a "mashed finger," resulting from the member being caught in closing a window, or from lack of precision in using a hammer. The firm bone beneath and the blow above usually contuse (bruise) the tissues (veins, vessels, muscles, etc.) between, and often the pain and other symptoms last some days. Wrap up in a bandage of old muslin, and keep constantly wet with cold water. If there is much pain add laudanum, and drill a small hole through the nail, so as to let out the accumulated blood. The discoloration and swelling may remain some days after the pain subsides. Stimulating liniments can now be used to encourage an extra flow of pure blood to the part.

Dislocations.

These occur when one bone is displaced from another at a joint. Little can be done to reduce them except by surgical aid. If possible, do not remove the patient.

Dog Bites.

Remove the clothing, if any, from the bitten part, and apply a temporary ligature above the wound. This checks the circulation of the part, and to that extent delays absorption of the poisonous saliva. While other things are hurriedly prepared, some one whose lips and mouth are free from breaks might attempt suction of the wound. The material extracted by sucking should, of course, be at once ejected from the mouth of the person giving the assistance. The bite is really a lacerated and contused wound, and lying in the little roughnesses, and between the shreds, is the poisonous saliva. If by any means these projections and depressions affording the lodgment can be removed, the poison must go with them. If done with a knife, the wound would be converted into a incised wound, and would require treatment as such. If a surgeon is about, he would probably stand a probe upright in the wound, and with a sharp knife cut out the entire injured portion. Professional aid is not always at command, and in such a case it would be well to take a poker or other suitable piece of iron, heat it red hot, at least, in the fire, wipe off, and destroy the entire surface of the wound. As fast as destroyed, the tissue becomes white. An iron at white heat gives less pain than one "black hot," as smiths say; for in the latter instance the heat is scarcely sufficient to destroy, but only irritates, while in the former the greater heat at once destroys the vitality of the part with which it comes in contact. With a properly heated iron, not only the surface is destroyed, but the destructive influence extends beyond and into the healthy tissue far enough, if no point is neglected, to assure against infection.

If the wound is at once well wiped out, and a stick of solid nitrate of silver(lular caustic) rapidly applied to the entire surface of the wound, little danger is to be apprehended. It acts, but in a milder degree, like the heat of the iron upon the tissues. In case the heat or the caustic has been used, poultices and warm fomentations should be applied to the injury to hasten the sloughing of the parts. The Pasteur treatment is recommended where possible, if near a Pasteur Institute, which is maintained in many large cities. No delay should be brooked.

Drowning.

Rules for Artificial Respiration in the Treatment of the Drowned.—Rule I (Fig. 1).—To Drain and Force Water from the Lungs and Stomach.—Instantly place patient face downward, a hard roll of clothing being placed beneath the pit of the stomach, to raise it as much as possible above the level of the mouth.

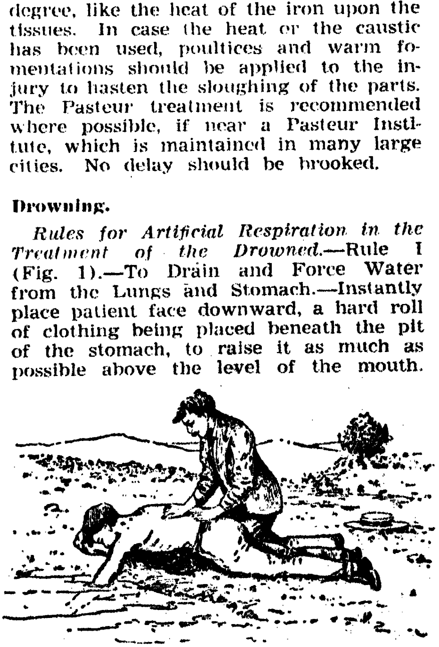

Fig. 1.—Expelling Water From the Body.

Put one wrist of the patient under his forehead to raise his mouth off the ground. With hands well spread upon the patient's back, above the roll of clothing, throw upon it your whole weight with a forward motion, and keep up the pressure about three seconds, so as to force all water from the stomach and lungs out of the mouth, ending the pressure with a push which will help to jerk you back to your upright position. Repeat this once or twice, and then quickly proceed with—

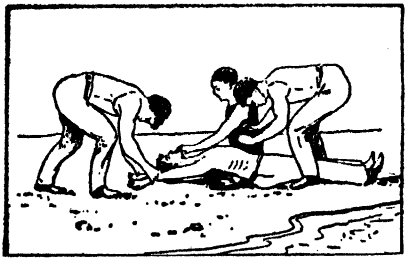

Fig. 2.—Movements to Produce Inspiration.

Rule II (Fig. 2).—To Make the Patient Breathe.—Turn the patient face upward, the same hard roll of clothing being now beneath his back, the shoulders slightly drooping over it. Bend the head backward and downward, putting the throat on the stretch to the utmost. Place the hands of the patient on the top of his head; one twist of a handkerchief or string around the crossed wrists will keep them there. Rip or strip all clothing from waist and neck. Now kneel astride the patient's hips. Grasp the front part of the chest on both sides of the pit of the stomach, your thumbs pointing to patient's chin, and your fingers fitting into the grooves between the short ribs. Fix your elbows firmly, making them one with your sides and hips, and then, firmly pressing the sides of the patient together, and using your knees as a pivot, throw yourself slowly forward two or three seconds until your face almost touches the face of the patient and your whole weight presses upon his chest. End this pressure with a short push which suddenly jerks you back again to the upright kneeling position.

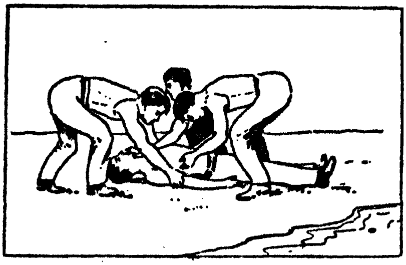

Fig. 3.—Movements to Produce Expiration.

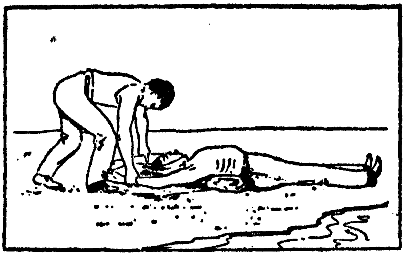

Fig. 4.—Movements by One Person to Produce Inspiration.

Rest three seconds while the ribs spring back; then repeat this bellows-blowing movement as before, gradually increasing the rate from seven to ten times a minute; but take the utmost care, on the occurrence of a natural gasp, not to interrupt it, but, as the ribs fall, gently press them and deepen the gasp into a longer breath. Continue this until the natural breathing, which you are imitating, needs no further assistance. If all fails, keep on, because any moment within an hour's effort you may be unexpectedly rewarded with success.

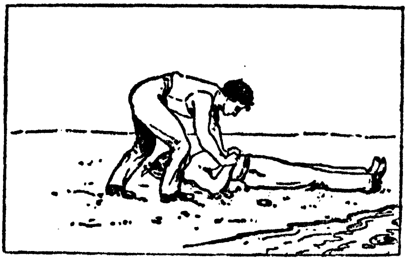

Fig. 5.—Movements by One Person to Produce Expiration.

Avoid impatient vertical pushes; the force must be upward and inward, increased gradually from zero to the maximum the age, sex, etc., may indicate.

If a second person be present and can do it, the tongue should be held out of one corner of the mouth by the thumb and finger, armed with a piece of dry cotton or linen rag.

Earache.

Evaporate the alcohol from a teaspoonful of laudanum; add half as many drops as you started with of glycerine or sweet oil; make this milk-warm, and pour into the ear, taking hold of the upper tip and pulling toward the crown of the head; or, wet a scrap of linen in a teaspoonful of laudanum, dry before a fire, cut into bits, place in the bowl of a tobacco-pipe, light it, cover with a coarse handkerchief, insert end of the stem (mouthpiece), suitably protected so as not to hurt, into the ear. Then apply this lips to the bowl and blow the smoke from the burning opium of the laudanum into the ear.

Eye, Foreign Bodies in.

Particles of cinder, dust or fragments of metal often get into the eye, and cause a great deal of trouble. Generally they are dislodged and washed out by the extra secretion of tears due to the irritation, but sometimes it is necessary to resort to some process of extraction. A popular and often successful plan is to take hold of the lashes of the upper lid and separate it from the eyeball, so that the lashes of the lower lid will slip up into the space, acting as a brush to the inner surface of the upper eyelid. This cannot, as a rule, remove anything from the eyeball. A better way is to hold a knitting needle or a match over the upper lid, close to and just under the edge of the orbit, firmly, but without much pressure. Then seize the lashes of that lid with the fingers of the disengaging hand, and gently turn the lip upward and backward over the needle, or the substitute used. Movement of the eyeball by the sufferer, in a strong light, usually reveals the presence of the intruding body, so that by means of a corner of a silk or cambric handkerchief it can be detached and removed.

Should the foreign body be imbedded in the mucous membrane covering the eyeball or the eyelid (conjunctiva), a steady hand and a rigid instrument will usually lift it out. A very useful spud for such a purpose is the butt of a clean pen. A drop or two of cocaine solution, five or ten per cent., will deaden the sensibility of the eye, and materially facilitate the removal of the foreign body. This solution dilates the pupil, but the effect passes off in a few hours.

Face-ache.

This usually is neuralgic, and the application of heat is always grateful. A small hop-pillow heated and held to the face is useful; or the face may be bathed with laudanum, tincture of arnica or any soothing substance. Mustard plasters should not be used, as they leave a conspicuous mark, and may blister. Ordinary Cayenne pepper mixed into a stiff paste with an equal bulk of Indian meal and honey is quite as active and useful, and does not blister the skin.

Fainting.

1. The head of the person who has fainted should be kept lower than the rest of the body. Should he be sitting in a chair at the moment, stand behind the chair, extend your hands over in front, so as to grasp the sides of the chair, take a step backward, and then slowly depress the back, the head being supported until the floor is reached. An assistant holding the knees will prevent the patient slipping from the seat of the chair. It is so rapidly and easily done, besides so effective in its operation, that little else remains to do. Usually the back of the patient's head scarcely reaches the floor before consciousness returns. If it does not suffice, some stimulant should be given, as stated in the treatment of "Shock."

2. *Stimulant in Fainting Spells.*—*Medecine moderne* says that from 15 to 20 drops of either of the following remedies produces rapid recovery from a fainting spell:

a.—Alcohol, 5 parts; ether, 5 parts; chloroform, 5 parts; menthol, 1 part; liquor ammoniae, 1 part. Mix. Pour on a handkerchief and let patient inhale same.

b.—Alcohol, 10 parts; ether, 5 parts; menthol, 1 part; pyridin, 2 parts; acetic acid, glacial, 3 parts. M. Sig. As above.

Fish, Poisonous.

Several varieties of fish, at all seasons of the year, are reputed to be poisonous. These should, of course, always be let alone. Should they have been eaten by accident, the best treatment is that given under the head of "Poisoning by Mushrooms."

Shellfish, at certain seasons of the year, after spawning, are considered poisonous; at least, they are unwholesome. This process of nature is known to be very exhausting, and during it, or just afterward, the shellfish is so reduced in vitality as to be unable to resist the ordinary tendency to decomposition. Oysters in hot weather are often unwholesome, perhaps from the causes suggested.

Fish Bone in the Throat.

A raw egg taken immediately will carry down a fish bone that cannot be gotten up from the throat.

Foul Air in Drains and Privies.

This usually consists of sulphuretted hydrogen, and arises from the decomposition of the residual matters found in these situations. Great caution, on this account, should always be observed on opening and entering such places, or places in possible communication with them, especially if they have been long closed. A small quantity of pure sulphuretted hydrogen, if inhaled, is usually fatal; but in the cases referred to the gas usually exists diluted with common air. The breathing becomes difficult, the person loses his strength, falls, becomes insensible and cold, the lips and face are blue, and the mouth is covered with bloody mucus. The person should be removed as quickly as possible beyond the influence of the foul air, and the treatment described for asphyxia by carbonic-acid gas should be applied.

The possibility of such a disaster should always be borne in mind in opening long-closed or privy-vaults, and the danger lessened by taking a few pounds of chloride of lime (bleaching powder), dissolving it in a pailful of water, and dashing it into the cavity. In the absence of this, lime and water in the form of the common "whitewash" may be employed. The gas readily combines with lime, to that extent freeing the air of the poisonous compound.

Fractures.

Very little can be done in case of fracture till a physician arrives. In a simple fracture only the bone is broken and there is no break in the skin; in a compound fracture the skin is also broken, and sometimes the bone protrudes. There is always some shock and great pain in the broken bone. If surgical assistance can be obtained without removing the patient, he should be left lying quietly. All that need be done is to cut the clothing over the affected part and put on it cloths wet with cold water, which will allay the pain to some extent. If no surgeon can be had, it will be necessary to make a splint which will hold the limb immovable. Two pieces of board will answer. They should be well padded with cotton batting, or anything else which will be soft enough to take off the pressure of the direct boards. Canes or umbrellas have been used in extreme cases. The patient should then be placed very gently on a litter made of a shutter or bench, and carried very carefully home. The treatment for a compound fracture is about the same as for a simple fracture.

Freezing.

In general freezing (short of actual death), keep the patient away from the heat. Take him to a cold room and rub him vigorously, especially the extremities, with snow, or cloths wet with cold water. The friction will re-establish the circulation slowly; whereas the rapid thawing out caused by immediate application of heat is apt to be followed by sloughing of the frozen parts.

The above applies to dry heat, *i.e.*, direct from a fire. It is advised by some, however, to put the frozen person at once in a warm or hot bath, and leave him there until thoroughly warmed through. If the breathing has stopped or is very slow, try to re-establish it or help it by artificial respiration. When the patient begins to breathe naturally and to regain consciousness, give stimulants, a little brandy or whisky, or hot beef tea, or hot milk, or hot coffee, very little at a time and frequently; that is, one or two teaspoonfuls every two or three minutes, until he has revived enough to take a larger quantity with ease. Until sure that no portion of the body—for example, a hand or foot—is still frozen, do not expose the patient to the direct heat of a fire, but bring him into warmer air gradually. When fully restored from the acute frozen condition, a few days of rest and careful feeding and good nursing will generally end in full recovery.

Gas.

Persons retiring at night very often leave the gas "turned down," and the flame becomes extinguished. Enough gas may then escape to give trouble to the sleeper, unless the room is well ventilated. Persons have been known to "blow it out" as they would a candle, and suffocation more or less complete has followed. Treat as in the asphyxia from carbonic-acid gas, just described.

Ice, Protection Against Slipping on, Etc.

Let 50 grams of thick turpentine, 200 grams of rosin, 50 grams of benzine and 250 grams of alcohol stand in a bottle in a warm place until a dissolution of the turpentine and the rosin has taken place.

With this solution coat the shoe soles several times and allow the liquid to soak in. This medium, which has been named "leather-sole fluid" by E. Soxhlet, also preserves the leather.

Lightning.

A person struck by lightning is usually rendered unconscious or nearly so. A temporary paralysis of the body may result for a while. When death takes place it is from shock to the brain and nervous system. When the person exhibits little or no sign of life, the clothing should be removed rapidly and the body subjected to a dashing of cold water, then dried and placed in bed and warmth applied, particularly to the pit of the stomach, by means of hot cloths or rubber bottles filled with hot water. Artificial respiration should be kept up for an hour or so, or until natural breathing is resumed. Recoveries after an hour of supposed death are on record. Brandy or aromatic spirits of ammonia should be given.

Meats, Poisonous.

The eating of meat from diseased animals is often followed by symptoms of a poisonous character. Animals otherwise in perfect health, but which have been butchered and prepared for food after long and exhaustive confinement, are unfit for eating. Not only is the meat of such animals lacking in nutritive character, when compared with the meat of animals killed from the pasture without excitement, or after being kept until proper recovery from the effects of the journey to market, but it is much less savory, and shows a disposition to decompose much more readily. It has been estimated by competent authorities that between the two kinds of meat there is, so far as nutriment is concerned, a difference of nearly fifty per cent. in favor of the meat of healthy animals butchered after complete recovery from the excitement and fatigue of drive or carriage to market. The additional cost per pound of meat to cover the expenses of extra care and precaution before butchering would amount to but a small fraction of the percentage named, leaving the rest of it a true profit to the consumer.

The eating of this overdriven meat is sometimes followed by symptoms of irritation of the stomach and bowels; but these symptoms can scarcely be said to be of a poisonous character, in the ordinary sense of the word, however much the use of such meat may temporarily derange the health.

Mushrooms.

When poisoning from eating mushrooms takes place, the contents of the stomach should at once be evacuated with an emetic. After vomiting has comenced, it should be promoted by draughts of warm water or barley water, but particularly by drinking copiously of warm milk and water, to which sugar has been added.

What has passed into the bowels should be hurried out as fast as possible, with some cathartic, before further absorption into the blood can take place.

If there is much prostration, some easily procured stimulant may be useful, as aromatic spirits of ammonia or brandy. A very excellent antidote is tincture of belladonna, ten drops in a little water every hour, until four or five doses have been taken.

Poison Ivy.

1.—Symptoms: Contact with, and with many persons the near approach to, the vine gives rise to violent erysipelatous inflammation, especially of the face and hands, attended with itching, redness, burning and swelling, with watery blisters. Treatment: Give saline laxatives and apply weak lead water and laudanum, or lime water and sweet oil, or bathe the parts freely with spirits of niter. Anointing with oil will prevent poisoning from it.

2. It is claimed that if those parts which have been touched by the poisonous plant be promptly washed with 70 per cent. alcohol there will be no manifestations of the poisonous symptoms. Alcoholic solution of sugar of lead is said to give prompt relief when the poison has been effective.

3.—One of the best preparations is the fluid extract of serpentaria, freely applied to the affected part.

4.—Bicarb. soda, 375 gr.; powdered borax, 150 gr.; carbolic acid, 160 min.; rose water, 33 1-3 fl.oz. Mix and filter. Apply freely to the poisoned parts. If much inflamed wet a cloth and keep in contact with the parts affected.

5.—*Poison Oak.*—a.—Dr. James J. Levick, of Philadelphia, writes to *The Medical News:* "In a case of poisoning of the hands from Rhus toxicodendron—poison oak—recently under my care, which had reached the vesicular stage and was attended with much swelling and burning, the happiest results promptly followed the free dusting of the powder of aristol on the affected parts. The change was almost magical, so sudden and so prompt was the relief afforded.

b.—Saturated solution of lead acetate in 50 or 75 per cent. alcohol. The milky fluid should be well rubbed into the affected part, and the operation should be repeated several times during the course of a few days. The itching is at once relieved and the further progress of the malady arrested. The remedy had been tried in a large number of cases and had always proved successful. It must be remembered, however, that it is a violent poison when taken internally, and hence care in its use must be exercised. No doubt an ointment of lead acetate, prepared with lanolin or other bland ointment base, would be equally effective.

POISONS AND ANTIDOTES

General Principles.

The following notes on treatment in cases of poisoning, by Edmund White, B.Sc. (Lond.), F.I.C., are reprinted, by permission, from the "Pharmacopoeia of St. Thomas's Hospital":

1. Remove by lavage or emesis any poison which remains in the stomach, or chemically neutralize it.

For lavage, use a soft stomach-tube and warm water containing the appropriate chemical antidote, if such be available, in solution or suspension.

For emetics, see list below.

(Caution! avoid lavage and emesis in poisoning by corrosive substances.)

2. Administer the physiological antidote, if one be known. See list below.

3. Hasten elimination of the poison.—Intravenous infusion of normal saline solution in poisoning with alkaloids. Aperients. (Caution! Avoid castor oil in phosphorous poisoning.)

4. Treat other symptoms as they arise:

Collapse.—Hot bottles. Caution! Beware of burning an unconscious patient. Hot blankets. Strong coffee by mouth or rectum. Elevate foot of bed.

Syncope.—Recumbency. Subcutaneous injections of ether or strychnine. Arom. sp. of ammonia in water, by the mouth. Faradism. Mustard papers to precordial region.

Respiratory Failure.—Artificial respiration. Cold affusion. Tracheotomy, if there is laryngeal obstruction. Oxygen inhalation.

Pain, if severe.—Morphine hypodermically.

5. When poison has been eliminated,

as far as possible, give demulcents (see following list).

List of Antidotes.

The following articles are the most useful antidotes in cases of poisoning. The quantities given are for adults and for a single dose, which must be repeated, within the limits of safe dosage, according to the severity of the symptoms and the quantity of poison ingested.

Emetics.

1. Apomorphine Hydrochloride, 1-10 gr. for hypod. inj.
2. Powd. Ipecac. (*not* Pulv. Ipecac. *Co.*, 30 gr. in water.
3. Liq. Ext. of Ipecac., 20 m. in water.
4. Mustard, one tablespoonful in 8 oz. water.
5. Common Salt, one tablespoonful in warm water.
6. Zinc Sulphate, 30 gr. in 8 oz. warm water.

If there is delay in obtaining emetics tickling the fauces may be resorted to.

Demulcents.

7. Milk.
8. Olive Oil.
9. Thick Gruel (fine oatmeal, 1 oz., mixed and boiled with 10 oz. of water).
10. White of Egg.

Stimulants.

11. Brandy, ½ oz. in 2 oz. water.
12. Strychnine Hydrochloride, 1-60 gr. for hypod. inj.
13. Ether, 30-60 m., for hypod. inj.
14. Arom. Spt. of Ammonia, 60 m. in water.
15. Smelling bottle, for ammonia inhalation.
16. Coffee, 2 oz. to be boiled with ½ pint water.
17. Mustard Papers, to be moistened with tepid water.

Chemical Antidotes.

18. Chalk, Whiting, or Wall Plaster, ½ oz. stirred up in water.
19. Sodium or Potassium Bicarbonate, 120 gr. in water (only used for acids in absence of magnesia and chalk, on account of the rapid evolution of gas).
20. Magnesia, ½ oz. stirred up in water.
21. Sacch. Sol. of Lime, 1-2 fl.drm. in water.
22. Citric or Lemon Juice, 1 oz. diluted with water.
24. Magnesium or Sodium Sulphate, ½ oz. in 8 oz. of water.
25. Hydrated Ferric Oxide, produced when required by adding to ½ oz. Sol. of Ferric Chloride in 8 oz. of Water, ¼ oz.

Magnesia or 2 fl.drm. Sol. of Ammonia (not Liq. Ammon, Fort.).

26. Copper Sulphate, 2½ gr. in 2 or 3 oz. of water.

27. French Turpentine or Sanitas, 30 m. in 1 oz. of water, repeated about four times in the first hour.

28. Potassium Permanganate, 5 gr. in ½ pint of water.

29. Tannic Acid, 20 gr. in water, or strong overdrawn tea.

Physiological Antidotes.

30. Amyl Nitrite Capsules, 3 m., for inhalation.

31. Atropine Sulphate, 1-60 gr. for hypod. inj.

32. Chloral Hydrate, 40 gr. in 3 oz. of water, by rectum or mouth.

33. Chloroform for inhalation.

34. Digitalis Tincture, 20 m. for hypod. inj.

35. Morphine Tartrate, 1-3 gr. for hypod. inj.

36. Pilocarpine Nitrate, ¼ gr. for hypod. inj.

37. Potassium Bromide, 30-60 gr. in water, by the mouth.

Normal Saline Solution.

38. Common Salt, 60 gr. in 1 pint of sterilized water at body temperature.

Treatment in Special Cases.

The various poisons are arranged in groups, alphabetically, under the name of the active principle or typical member of each group. Apply in all cases the general principles of treatment, modified or supplemented as described under each group. The numbers refer to the numerical arrangement of the substances in the list of antidotes.

Acids, Mineral.—Hydrochloric, Nitric, Sulphuric, Spirit of Salt, Muriatic, Aqua Fortis, Acetic, Butter of Antimony, Soldering Fluid, Battery Fluids.

Caution! Lavage or emesis inadmissible. Chemical antidotes, 20, 18, 19, 21. Demulcents, 7, 10, 9.

Acid, Oxalic.—Salt of Sorrel, Salt of Lemon.

Caution! Lavage or emesis only if case is treated soon after ingestion of poison, and then cautiously. Chemical antidotes, 18, 21, *not* 19 or 20.

Acid, Carbolic.—Creosote, Disinfecting Fluids.

Lavage with care. Wash out with 24. Demulcents, 8, 7. Stimulants freely. Intravenous or rectal injection of saline solution.

Acid, Hydrocyanic. — Cyanides, Bitter Almond Oil.

Treatment for respiratory failure. Stimulants, 13, 14, 15, 11.

Aconite.—Monkshood, Aconitine.

Treatment for respiratory failure. Stimulants, 12, 11. Saline infusion.

Alcohol.

General principles, especially cold affusion, Faradism and artificial respiration.

Alkalies. — Potash, Soda, Ammonia, Hartshorn, Weed-killer.

Caution! Lavage or emesis inadmissible. Chemical antidotes, 22, 23. Demulcents, 8, 7, 10. Stimulants.

Antimony Salts.—Tartar Emetic, Butter of Antimony.

General principles, especially stimulants and treatment for collapse. Caution! Avoid lavage after Butter of Antimony (see Acids). Emesis generally occurs from action of poison; give copious draughts of warm water. Chemical antidote, 29. Demulcents, 7, 10.

Arsenic Compounds.—White Arsenic, Weed Killers, some Vermin Killers, Sheep Dips, some Fly Papers.

General principles, unless in poisoning by strongly alkaline weed killers, when lavage must be applied cautiously or not at all. Chemical antidote, 25. Demulcents.

Atropine. — Nightshade, Belladonna, Stramonium, Hyoscyamus.

General principles, especially treatment for respiratory failure. Chemical antidote, 29. Physiological antidote, 36.

Barium Salts.

General principles. Chemical antidote, 24.

Camphor. — Camphorated Oil (Lin. Camph.).

General principles.

Cantharides.

General principles. Caution! Proceed carefully if mouth or esophagus be blistered. Demulcents.

Chloroform.

General principles, especially fresh air, stimulation and artificial respiration. Physiological antidote, 30.

Cocaine.

General principles, with stimulants, 14, 15, 12. Physiological antidote, 30.

Copper.—Blue Vitriol, Verdigris.

General principles. Chemical antidote, 19 (or Potassium Ferrocyanide, 10 gr. in 2 oz. of water). Demulcent, 7, copiously.

Digitalis.—Foxglove.

General principles. Chemical antidote, 29.

Gases.—Carbon Monoxide, Carbon Dioxide, Coal Gas, Sewer Gas, Acetylene, Chlorine, Nitrous Fumes.

General principles, particularly artificial respiration and oxygen inhalation.

Hypnotics.—Chloral Hydrate, Chloralamide, Sulphonal, Paraldehyde.

General principles. Stimulants, particularly 12.

Iodine.

General principles. Chemical antidote, 21. Demulcents, copiously.

Irritants, Vegetable. — Unidentified Plants, Violent Purgatives, Nicotine, Tobacco, Savin, Squill.

General principles. Demulcent, 7, freely by stomach tube.

Lead Salts.

General principles. Chemical antidote, 24.

Mercury Salts. — White Precipitate, Red precipitate.

General principles. Demulcents, 10 and 7, freely.

Mineral Oils.—Benzoline, Paraffin, Petroleum.

General principles. Demulcent, 8, freely, followed by free lavage with milk.

Morphine.—Opium, Codeine, Syrup of Poppy, Soothing Syrups, Chlorodyne, Laudanum, Paregoric.

General principles. Chemical antidote, 28, freely washing out after use. Physiological antidote, 31. Stimulants freely, but do not overdo rousing, forced movements and exposure.

Phosphorus.—Rat Pastes.

General principles. Chemical antidotes, 26, 27. Demulcents. Caution! avoid oil.

Ptomaines.—Stale Food, Canned Food.

General principles, especially treatment for collapse. Chemical antidote, 29.

Silver Salts.

General principles. Chemical antidote, 55.

Strychnine.—Vermin Killer.

General principles. Chloroform by inhalation, emesis by apomorphine, or lavage as soon as patient is under influence of chloroform. Chemical antidote, 29. Physiological antidote, 37 or 32.

Turpentine. — Polishing Fluids or Pastes.

General principles. Lavage with milk.

Zinc Salts.—White Vitriol, Burnett's Fluid, Soldering Fluid.

Caution! Lavage and emesis inadmissible except in poisoning with neutral zinc salts. Chemical antidote, 19. Demulcent, 7, copiously.

Medicinal and Fatal Doses of Poisons:

Acetic Acid, Glacial.—Symptoms: Corrosion, perforation, odor, abdominal pain, collapse. Treatment: Not stomach pump; soap and water, lime, magnesia, milk, oil, thick gruel. Morphia against shock.

Aconite, monkshood, wolfsbane, blue rocket.—Symptoms: Tingling and numbness, warmth at pit of stomach, paralysis from below up. Pulse and respiration depressed; mind clear. Treatment: Stomach pump or emetic; stimulants; atropia, hypodermic. Keep warm and recumbent. Digitalis hypodermic; amyl nitrite. Artificial respiration.

Alcohol, brandy.—Symptoms: Intoxication, giddiness; lips livid; convulsions; coma; stupor. Treatment: Stomach pump or apomorphia hypodermic; battery, coffee, douche, amyl nitrite.

Almonds, oil of bitter. See *Hydrocyanic Acid.*

Ammonia.—Symptoms: Burning pain in mouth, stomach and chest. Membranes swollen, red; difficult breathing, bloody vomiting; pulse slow; pallor, loss of voice. Treatment: Not stomach pump. Vinegar, lemon juice; remulcent drinks; tracheotomy, inhalation of steam or chloroform; morphia, hypodermic, for shock.

Antimony, Tartar Emetic.—Symptoms: Metallic taste, vomiting, choking sensation; pain in stomach, purging; thirst, cramps, cold sweat; head congestion, faintness; pulse and breathing weak; collapse. Treatment: Tannic or gallic acid; tea, coffee, demulcent drinks; stimulants; morphia, hypodermic.

Antipyrine. — Antipyrine, antifebrin, acetanilid and many other anti remedies which are used for headaches and neuralgia are poisonous in large doses. They act chiefly by depressing the heart's action. Besides emetics, the treatment consists of the free administration of stimulants, such as aromatic spirits of ammonia, coffee, whisky, etc.

Aquafortis. See *Nitric Acid.*

Arsenic, Vermin Killers, etc.—Symptoms: Faintness, depression, burning pain; vomiting, purging; cramp, tightness in throat, thirst; pulse slow, breath painful, skin clammy; collapse. Treatment: Stomach pump, or apomorphia, hypodermic. Empty and wash the stomach well. Dialys, iron; magnesia, castor oil. Stimulants: Mucilaginous drinks. Warmth. Morphia, hypodermic.

Arum Maculatum, Cuckoo paint; lords and ladies, cows and calves; wake-robin. —Symptoms: Vomiting, purging, convulsions; pupils dilated; coma; tongue swells. Treatment: Emetic, castor oil, coffee.

Atropine, Belladonna. See *Belladonna.*

MEDICINAL AND FATAL DOSES OF POISONS

Name of Poison.	Maxim Medicinal Dose.	Recorded Fatal Dose.
Acetanilide	3 grains	120 grains
Acid Arsenious	1-15 grain	2 grains
Acid Boric	15 grains	variable amount
Acid Carbolic	3 grains	60 grains
Acid Hydrochloric	—	1 fl. drachm
Acid Hydrochloric, Diluted	20 minims	
Acid Hydrocyanic, Diluted	6 minims	30 minims
Acid Nitric	—	2 fl. drachms
Acid Nitric, Diluted	20 minims	
Acid Oxalic	—	60 to 180 grains
Acid Sulphuric	—	1 fl. drachm
Acid Sulphuric, Diluted	20 minims	
Aconite Root	—	60 grains
Aconite, Green Extract of	1 grain	2 grains
Aconite, Tincture of	15 minims	1 fl. drachm
Aconitine	—	1-30 to 1-15 grain
Alcohol	—	3 to 5 fl. ounces
Ammonia, Strong Solution of	—	1 fl. drachm
Aniline	—	4 fl. drachms
Antimony, Tartarated	1-8 grain as a diaphoretic 2 grains as an emetic	5 to 15 grains
Atropine and its Salts	1-100 grain	½ to 2 grains
Barium Salts	—	100 grains
Belladonna, Liquid Extract of	—	1 fl. drachm
Belladonna, Liniment of	—	1 fl. drachm
Belladonna Berries	—	14 berries
Bismuth Salts	20 grains	
Bismuth Oxynitrate	20 grains	120 grains
Bromine	—	2 minims
Brucine	—	6 grains
Camphor	1-3 grains	1 ounce
Carbon Bisulphide	—	4 fl. drachms
Carbon Monoxide	—	1 p.c. is dangerous
Chloral Hydrate	20 grains	30 grains
Chloroform	5 minims	4 fl. drachms
Cocaine	½ grain	1 to 2 grains
Codeine	2 grains	4½ grains
Colchicum Corm	5 grains	48 grains
Colchicum, Extract of	1 grain	
Colchicum, Wine of	30 minims	3½ fl. drachms
Colchicum Seeds	—	60 grains
Coniine	—	1 drop
Copper Oxyacetate (Verdigris)	—	½ ounce; Daily dose of 3½ grains
Croton Oil	1 minim	2½ fl. drachms
Digitalin	—	¼ to ½ grain
Digitalis Leaves	2 grains	38 grains
Digitalis, Infusion of	4 fl. drachms	
Digitalis, Tincture of	15 minims	9 fl. drachms
Ergot	½-2 fl. dr.	1 ounce
Foxglove, see Digitalis.		
Ferric Chloride, Tincture of	15 minims	1½ fl. ounces
Gelsemium, Liquid Extract of	—	3 fl. drachms
Gelsemium, Tincture of	15 minims	4 fl. drachms
Hyoscine Hydrobromide	1-100 grain	1-8 grain
Hyoscyamus, Tincture of	1 fl. drachm	4 fl. drachms
Iodine	—	1½ grains
Iodine, Tincture of	5 minims	1 fl. drachm
Lead Acetate	—	1 to 2 ounces
Lead Carbonate	—	1 to 2 ounces
Lobelia Herb	—	60 grains
Magnesium Sulphate	½ ounce in one dose ¼ ounce for repeated doses	1 to 4 fl. ounces
Mercuric Chloride (corrosive sublimate).	1-16 grain	2 to 5 grains
Mercuric Oxysulphate (Turpeth mineral).	—	40 grains
Mercurous Chloride (Calomel)	5 grains	6 grains
Mercurry Ammoniated	—	35 grains
Morphine and its Salts	½ grain	1 grain
Nicotine	—	1 to 3 drops
Nitrobenzene	—	20 minims
Nitroglycerine	1-50 grain	1 ounce
Nux Vomica	4 grains	40 grains
Oil of Almonds, Essential	—	30 minims
Opium	2 grains	4 grains
Opium, Tincture of	15 minims for repeated doses 30 minims in one dose	2 fl. drachms
Phenol, see Acid Carbolic.		
Phosphorus	1-20 grain	1-8 to 2 grains
Potassium Bichromate	1-5 grain	120 grains
Potassium Chlorate	15 grains	1½ ounces
Potassium Cyanide	—	5 grains
Potassium Hydroxide	—	40 grains
Potassium Hydroxide, Solution of	30 minims	
Potassium Iodide	20 grains	5 grains in 'iodism'
Potassium Nitrate	20 grains	120 grains
Salol	15 grains	15 grains
Silver Nitrate	½ grain	50 grains
Stramonium Seeds	—	100 seeds
Stramonium Extract	1 grain	8 grains
Strychnine and its Salts	1-15 grain	½ to 2 grains
Sulphonal	30 grains	1 ounce
Tobacco	5 grains as an emetic	6 grains
Turpentine	10 minims ½ fl. ounce as an anthelmintic.	6 fl. ounces
Verdigris, See Copper.		
Zinc Chloride	—	6 grains
Zinc Sulphate	2 grains as a tonic, 30 grains as an emetic	1½ ounces

Barium, Baryta.—Symptoms: Vomiting, pain in bowels, purging; pulse and breathing distorted; cramps, paralysis, giddiness. Treatment: Stomach pump or emetic; sulphates; warmth. Stimulants: Morphia, hypodermic.

Belladonna, Deadly Nightshade.—Symptoms: Mouth, throat hot; eyes sparkling, face flushed, pupils dilated; delirium, staggering; rash (?). Treatment: Stomach pump or emetic. Stimulants: Coffee; pilocarp., hypodermic; artificial respiration.

Benzol, Benzine. — Symptoms: Narcotic; twitching, difficult breathing, head noises. Treatment: Stomach pump or emetic. Stimulants: Atropia, hypodermic; douches, battery, artificial respiration.

Brucine. See *Strychnine.*

Calabar Bean. See *Physostigmine.*

Camphor.—Symptoms: Odor; faintness, languor, delirium, convulsions, coldness; pulse quick, breathing difficult. Treatment: Stomach pump or apomorphia, hypodermic. Stimulants: Warmth; douche.

Cantharides, Spanish Fly. — Symptoms: Burning pain, throat and stomach; diarrhea, salivation, albuminous urine; high temperature, headache, quick pulse; insensibility, convulsions. Treatment; Stomach pump (?) or emetic; demulcent drinks, no oil; morphia; baths; linseed poultice.

Carbolic Acid. — Symptoms: Burning pain in mouth and stomach; mucous membrane, white, hardened; skin, cold; pupils, contracted; urine, dark; insensibility; coma; collapse. Treatment: Stomach pump or emetic; soda or sacch. lime; white of egg; castor oil; stimulants; warmth; battery; atropia, hypodermic; nitric amyl; bleeding.

Carbonic Acid. See *Main Alphabet* in this chapter.

Caustic Potash or Soda. See *Potash,*

Chloral.—Symptoms: Sleep; loss of muscular power; reflex action; sensibility diminished; stertorous breathing. Treatment: Stomach pump or emetic; warmth; rousing; coffee; strychnine, hypodermic; nitric amyl; artificial respiration.

Chlorine.—Symptoms: Tightness; irritation, chest; cough; difficult breathing, swallowing. Treatment: Fresh air; inhale steam; dilute ammonia; sulphur; hydrogen; chloroform; ether.

Chloroform.—If swallowed: Stomach pump or emetic; carbonate soda solution; rousing; mustard to the heart; nitric amyl. If inhaled: Fresh air; douche; artificial respiration; nitrite amyl; battery.

Choke Damp. See *Carbonic Acid.*

Coal Gas.—Symptoms: Giddiness; insensibility; difficult breathing; asphyxia; coma. Treatment: Mustard to the heart. Also as for carbonic acid.

Cocaine.

1.—Cocaine is the active principle of Erythroxylon Coca, and is a prompt poison in overdose. It is largely used by surgeons as a local anesthetic in small operations, especially on the eye and nose. It has the power of reducing temporarily the congestion and swelling of inflamed mucous membranes. For that reason it is often introduced into powders and liquids which are to be sniffed up the nose for cold in the head or hay fever. These must be used with great care or else the cocaine habit will be formed, which is quite as serious as the opium habit. Acute poisoning may occur, though rarely, when used in this way.

In doses of four or five grains, taken internally, it has caused poisonous symptoms. These resemble closely those of opium poisoning, but the pupil of the eye is dilated instead of contracted and the respirations are not so diminished. The treatment is essentially the same as for opium poisoning, though the need for artificial respiration is not so great.

2.—Equal parts of amyl nitrite and alcohol. M. et sig.: Inhale the vapors thus produced.

Cocculus Indicus. See *Picrotoxine.*

Colchicum, Meadow Saffron.—Symptoms: Vomiting; purging; throat irritation; thirst; sweat; twitchings; delirium. Treatment: Stomach pump or emetic; tannic, gallic acid; demulcent drink; stimulants; morphia.

Colocynth. — Symptoms: Vomiting; purging; cold; weak pulse; collapse. Treatment: Stomach pump or emetic; camphor, and similar to colchicum.

Conine, Hemlock.—Symptoms: Staggering; loss of muscular power; sight; difficult breathing, swallowing; asphyxia. Treatment: Stomach pump or emetic; tannic, gallic acid; warmth, artificial respiration; stimulants; atropia, hypodermic.

Copper.—Symptoms: Colic, griping; metallic taste; vomiting, purging; thirst, sweating, coldness, giddiness, coma. Treatment: Stomach pump or emetic; demulcent drink; morphia, hypodermic; linseed poultice.

Chromium, Chromates. — Symptoms: Vomiting; purging; cramps; depression;

suppression urine; pupils dilated. Treatment: Stomach pump or emetic; magnesia carbonate; chalk; gruel.

Croton Oil. — Symptoms: Abdominal pain, purging, vomiting; cold skin, collapse. Treatment: Stomach pump or emetic; camphor, stimulants, morphia; gruel; linseed poultice.

Curarine. — Symptoms: Paralysis of motors and respiration. Treatment: Artificial respiration; stimulants; ligature and wash wound.

Cyanides. See *Hydrocyanic Acid.*

Daturine. See *Atropine.*

Digitalis (Foxglove).—Symptoms: Abdominal pain, purging, vomiting; headache, small pulse, delirium, convulsions; cold skin, sweat; pupils dilated. Treatment: Stomach pump or emetic; stimulants; tannic acid; keep patient lying.

Ergot.—Symptoms: Tingling, cramps, vomiting, diarrhea. Treatment: Stomach pump or emetic; tannic, gallic acid; nitrate amyl; stimulants; keep warm, lying down.

Ether.—Symptoms: Anesthetic action. Treatment: Artificial respiration; fresh air; douche, stimulants; blows on chest if heart stops.

Fly Powders.—Generally treatment for arsenic.

Gas. See *Coal Gas.*

Gelsemium. — Symptoms: Giddiness; pain eyes and brows, double sight, weakness, suffocation, coma. Treatment: Stomach pump or emetic; douche; stimulants; artificial respiration.

Hydrochloric Acid, Muriatic acid; spirits; salts.—Symptoms: Burning pain, vomiting, thirst. Treatment: Not stomach pump (?); bicarbonate soda; magnesia, lime water, soap water, demulcent drinks; morphia, hypodermic.

Hydrocyanic Acid, Prussic acid.—Symptoms: Insensibility; pupil dilated, skin cold, sweating, difficult breathing. Treatment: Stomach pump or emetic; ammonia inhaled; stimulants; atropia, hypodermic; artificial respiration; battery.

Hyoscyamine. See *Belladonna.*

Iodine.—Symptoms: Stomach, throat pain, vomiting, purging, giddiness, faintness (starch test). Treatment: Stomach pump or emetic; starch; nitrite amyl; morphia.

Jaborandi.—Same treatment as pilocarpine; stomach pump or emetic.

Laburnum.—Symptoms: Purging, vomiting, drowsiness, convulsions. Treatment: Douche; stimulants; coffee.

Lead. — Symptoms: Metallic taste, thirst, colic, cramps, cold sweat, paralysis. Treatment: Stomach pump or emetic; sulphates; iodide potassium; morphia.

Lemons, Salt of. See *Oxalic Acid.*

Lobelia.—Symptoms: Vomiting, giddiness, tremors, convulsions, depression, collapse. Treatment: Stomach pump or emetic, tannic acid; warmth; stimulants; keep lying down.

Morphia. See *Opium.*

Muscarine, Fly fungus, mushrooms.—Symptoms: Colic, purging, vomiting, excitement, coma. Treatment: Stomach pump or emetic; stimulants, castor oil, warmth; atropia, hypodermic.

Nicotine. See *Tobacco.*

Nitrate of Potassium, Saltpeter.—Symptoms: Nausea, purging, vomiting, coldness, tremors, convulsions, paralysis, collapse. Treatment: Stomach pump or emetic; demulcent drinks, stimulants, warmth, nitrite amyl; atropia, hypodermic.

Nitric Acid. — Symptoms: Corrosion, vomiting, abdominal pain; difficult breathing. Treatment: Not stomach pump; magnesia, lime water, gruel, oil; morphia, hypodermic; tracheotomy.

Nitro-benzol, Artificial Essence Almonds. — Symptoms: Nausea, difficult breathing, drowsiness, stupidity; coma. Treatment: Stomach pump or emetic; stimulants; douche; artificial respiration; battery; atropia, hypodermic.

Nitrous Oxide.—Symptoms: Anesthesia. Treatment: Fresh air, oxygen; artificial respiration.

Opium.

1.—This substance, or the numerous preparations such as morphine, etc., is one of the most frequent causes of poisoning. A common mistake is that of confounding laudanum and paregoric. A teaspoonful of laudanum contains six grains of opium, but a teaspoonful of paregoric contains only one-quarter of a grain.

Treatment.—What is in the stomach must be taken out, to prevent further absorption, and what is in the blood must be worked out, under proper guidance, by the processes of nature constantly engaged with such products. The patient must be kept warm by blankets and hot-water bottles, care being taken that the latter do not blister him. An active emetic, like ground mustard, must be given at once, remembering that trouble may be found in getting it to act because of the diminished sensibility to its presence from the local stupefying action of the opium upon the mucous membrane of the stomach. The action of the mustard should be assisted by tickling the inside of the throat with the finger or a feather.

2.—Symptoms: Intoxication; sleep; pupils contract; respiration and pulse slow, depressed. Treatment: Stomach pump or emetic; rouse; inhale ammonia; douche; battery; atropia, hypodermic; nitric amyl; artificial respiration.

Oxalic Acid. — Symptoms: Vomiting, purging, cramps. Treatment: Chalk, sacch. lime; purgatives; no potash, soda or ammonia.

Phosphorus (matches). — Symptoms: Odor; vomiting; purple spots; delirium. Treatment: Emetic; French oil of turpentine; copper sulphate; purgative.

Physostigmine, Calabar bean.—Symptoms; Faintness, prostration, twitching, giddiness; no delirium. Treatment: Stomach pump or emetic, stimulants; artificial respiration; atropia, hypodermic; chloral; strychnia, hypodermic.

Picrotoxine. — Symptoms: Vomiting, weakness, sleep, eruption. Treatment: Stomach pump, chloral, potassium bromide.

Pilocarpine. — Symptoms: Sweating, salivation, headache, quick pulse. Treatment: Atropia, hypodermic, or belladonna by mouth.

Potash. — Symptoms: Caustic taste, corrosion, painful purging, skin cold. Treatment: Not stomach pump; vinegar, lemon juice, oil, demulcent drink.

Prussic Acid. See *Hydrocyanic Acid.*—Stomach pump or emetic.

Resorcin. — Symptoms: Prickling of the skin, giddiness, sweating, insensibility, white lips, dry tongue. Treatment: Albumen, soda, sacch. lime; stimulants; warmth, battery, nitrate amyl; atropia, hopodermic.

Savin.—Symptoms: Vomiting, painful purging, coma, convulsions. Treatment: Emetic, linseed poultice, purgative; morphia, hypodermic.

Soda. See *Potash.*

Soothing Sirup. See *Opium.*

Stramonium, Thorn apple. — Symptoms: Pupils dilated, delirium, rash on skin, paralysis, coma. Treatment: Stomach pump or emetic; coffee, stimulants; pilocarp., hypodermic; artificial respiration; mustard douche to limbs.

Strychnine. — Symptoms: Convulsions. Treatment: Stomach pump or emetic; potassium bromide; anemi; charchi; nitrite amyl; curare; artificial respiration.

Tartaric Acid. See *Acids.*—Symptoms: Convulsions. Treatment: Alkalies (potash and soda) and ammonia, not suitable. Use lime, castor oil.

Tobacco.—Symptoms: Vomiting, dim vision, weak pulse and cold skin. Treatment: Stomach pump or emetic; stimulant, strychnia, hypodermic; tannic acid; hot application to skin; keep patient lying down.

Turpentine.—Symptoms: Intoxication, coma, collapse, pupils contracted. Treatment: stomach pump or emetic; apomorphia if necessary; magnesia, sulphur; demulcent drink.

Veratrine.—Symptoms: Thirst, vomiting, painful diarrhea, headache, weak pulse. Treatment: Stomach pump or emetic; coffee, stimulants; warm application; keep patient lying down.

Zinc.—Symptoms: Painful vomiting, quick pulse and breathing, paralysis, coma. Treatment: Potassium or sodium carbonate; tannic or gallic acid; milk, eggs; morphia, hypodermic.

Ring, How to Remove.

When a ring is fixed on the finger from the swelling of the skin or joint, rub the finger with soap and cold water, and it will then generally admit of its removal. If this fails, take a strong thread or piece of fine twine, and, beginning at the end of the finger, wind it regularly around and around it, with the coils close together, till the ring is reached; then slip the end through the ring from the side next the end of the finger, and begin to unwind the string, which, as it progresses, carries the ring with it. Sometimes, however, when the finger is very much swollen, and when the ring is deeply embedded, even this plan will not succeed, and the only resource is to cut through the ring with a pair of cutting pliers, first slipping under it a thin piece of metal or cardboard to protect the skin from injury.

Sewer Gas.

Symptoms: Livid lips, conjunctivae injected, pupils dilated, insensibe, tonic convulsions, high temperature. Treatment: Fresh air, artificial respiration, ammonia. Coffee. Hot and cold douche.

Shock

Mild forms of shock, or collapse, as they are sometimes called, are often, by the non-professional, confounded with fainting (syncope), and an ordinary attack of fainting is analogous to shock. The symptoms of the two vary rather in degree and duration than in kind. In certain extreme cases where there is sudden and powerful emotion, or a blow in the pit of the stomach, life may be destroyed without leaving any sign. This is called "death from shock." There is pallor of the whole surface of the skin, the lips are bloodless and pale, the eyes lose their luster, and the eyeball is usually partially covered by the drooping upper lid. The skin is covered with a cold, clammy moisture, the temperature is low, and perhaps the person shivers. The mind is bewildered, the patient often insensible. Sudden and serious injuries, particularly if extensive, cause shock, as does a powerful current of electricity. The loss of blood produces or aggravates shock. Hence a slight injury with much loss of blood may be attended with more shock than a comparatively more severe injury without the loss of blood. A weak system is more easily affected by shock than a strong system. As a person grows older, there is less power available to meet injuries, therefore the aged are slow to rally from the effects of shock.

Treatment.—First place the patient flat of his back, with the head low. This is an important point. The vital powers being depressed, stimulants are required. The aromatic character of brandy enables it to be retained by the stomach when whisky and other forms of alcohol are rejected. A teaspoonful on cracked ice every minute, until six or eight have been taken, is the best way to give it. If the temperature of the body is raised by it, and there seems a revival of the action of the heart, enough brandy has been given. Twenty drops of aromatic spirits of ammonia in a teaspoonful of water may be given every two minutes, until four or five doses have been taken. Applications of heat to the extremities and "pit of the stomach" are very useful, in the shape of flannels wrung out in hot water, or bottles of hot water properly wrapped up. Mustard plasters may be used, but they are so inferior to heat for the purpose, if that can be applied, and so apt to blister, thereby making it impossible to use anything else on the surface, that some reluctance is felt in advising them.

Nausea and vomiting are often present in shock, and can best be allayed by getting the patient to swallow small chips of ice whole. Ice can be chipped easily by standing the piece of ice with the grain upright and splitting off a thin edge with the point of a pin.

Ammonia (smelling salts) applied to the nostrils is often useful, and cologne, on a handkerchief, is frequently pungent enough to be of service in the same way.

Snake Bite.

1.—Treatment: Cauterization and ligature. Stimulants: Permanganate, liquor potassae; artificial respiration; ammonia injection.

2.—Dr. Corislano d'Utra, of Brazil, says that persons suffering with snake bite may be cured in all cases by taking three doses, two hours apart, of 30 grains of calomel in an ounce of lemon juice. He further declares that whoever will carry about his person a bag containing from 75 to 300 grains of corrosive sublimate need have no fear of serpents. They will flee from him, and, if by chance he is bitten, the bite will be harmless!

3.—Dr. B. M. Ricketts (*Cincin. Lanc.-Clinic*, Vol. XLI, No. 9, 1898) is authority for the following: The copperhead, coral-snake and rattlesnake are the only serpents in the United States which possess fangs at the base of which is a sac containing poisonous fluid. The result of inoculation depends upon the dose and the size of the human being or animal. Most of the authentic cases of death of these serpents have been among children. No authentic record of death, as the result of the bite of any of these snakes, has been found in the adult man by himself. If death does not result within a few hours it is not the venom, but other agencies that produce it. The bite of the cobra is not so deadly as is generally supposed. Overstimulation from alcohol and other agencies is oftener the cause of death than virus inoculation. The effect upon the body is more severe if the virus is injected into blood vessels. There seems to be no subject which is surrounded by so much uncertainty and exaggeration.

The treatment is general and local. Strychnine nitrate hypodermically every twenty minutes until its physiological effects are produced, or until coma is overcome. Alcohol, digitalis, atropine and nitroglycerine are all more or less beneficial.

Locally the writer advises the use of a 1 per cent. solution of chromic acid; chloride of gold or permanganate of potassium may be substituted for chromic acid. Among other drugs he believes jaborandi, administered internally, to be of undoubtful benefit. Massage of the swollen parts and lavage of the stomach aid greatly in combating the poisoning.

Sprains.

These are due to the stretching and tearing of the ligaments around a joint, and are accompanied by great pain and swelling. Hot-water applications are the best to relieve the pain and reduce the swelling. The joint should be kept absolutely at rest. The best way to secure this is to strap the joint for some distance above and below with adhesive plaster, layer upon layer. Any weak spot which develops in the dressing can be easily reinforced by an extra layer or two. Care should be taken that the strapping is not so tight as to interfere with the circulation of the blood. This can be determined by noting whether the part below the strapping remains warm. If it becomes cold and remains so, the strapping is probably too tight and should be promptly removed. After all, sprains are very unsatisfactory to treat. Not infrequently they take a longer time to heal than a fracture, and the joint is usually left weakened.

Suffocation.

There are several gases which, when inhaled, are followed by symptoms of asphyxia. The condition is very similar to drowning, for these gases are not able to purify the blood by giving oxygen to it. Some of them, besides, are directly poisonous. (See cause of suffocation.)

Sunstroke.

Heat exhaustion differs from heatstroke in that the condition is one of very great depression, with a rapid, feeble pulse and heart action and a cold, moist skin and body temperature, instead of a hot skin with high fever. The treatment required is radically different from that employed in sunstroke. Take the person at once to a cool, shady, quiet place and give him plenty of fresh air and loosen the clothing around the neck. Send for a doctor on the first appearance of the symptoms.

Heat Exhaustion.—If the skin is cold and clammy, the case is one of heat exhaustion and must be treated accordingly. Do not apply cold to the surface, but apply heat by means of hot-water bottles or hot flannels and by rubbing the limbs. Give a tablespoonful of whisky or brandy in hot water or a teaspoonful of aromatic spirits of ammonia in water, or give strong tea or coffee. The object is to relieve the depression.

Sunstroke or Heatstroke.—On the contrary, for sunstroke or heatstroke, loosen the clothing around the neck and carry the patient to a cool place. If the skin is hot and the person seems feverish, cold applications are necessary.

If there is a bathtub at hand, fill it with cold water; put ice in the water if you can get it. Place the patient in the tub, all except the head, over which an ice cap should be placed. To make this, mash a piece of ice in a towel. Keep the patient in the tub for fifteen minutes and then put him in bed, between blankets, without drying him. If in fifteen minutes he shows no signs, or very feeble ones, of returning consciousness, replace him in the bath and treat him as before.

If there is no bathtub at hand, take off his clothes, wrap him in a sheet and keep this wet with cold water. If this cannot be done sponge head, neck, chest or other parts of the body with cold water, and if ice can be had, use this freely by rubbing over the chest and applying to the head and armpits. Repeat the baths at intervals of fifteen minutes until the patient stays conscious and the body remains cool.

If natural breathing does not return, perform artificial respiration, Sylvester's method. If ice cannot be obtained, wet towels with cold water and wrap the head in them, changing them frequently. The treatment is, in brief, to use any means to reduce the temperature of the body by applying cold externally.

Continue such treatment until the temperature of the skin is reduced. If the patient improves, but the symptoms of fever recur, renew the cold applications as before. If the patient is able to swallow, frequent drinks of cold water may be given him, but do not give any whisky or other alcoholic stimulants. Take care that the patient does not become stupid and his body hot again. If this happens, repeat the same methods. Medicines do not seem to be of much avail.

Throat, Foreign Bodies in.

In case an article of food, or other substance, gets into the back of the mouth and cannot be swallowed, it should be dragged out with the aid of a hairpin straightened and bent at the extremity. If the body is firm in character, a pair of scissors, separated at the rivet and one blade held by the patient, will furnish a loop with which it may be extracted.

Toothache.

This is sometimes neuralgic and sometimes due to decay. Heat applied to the face outside, and a heated half of a fig held inside, often relieve the former kind, and sometimes afford temporary relief in the latter kind. If the cavity can be cleansed out with a broom splint and filled with cotton steeped in evaporated laudanum much comfort will be found.

Wasp and Bee Stings.

Carbolic acid in crystals, 1 dram; glycerine, 4 drams; distilled water, 1 dram. Dissolve the acid by the aid of a little heat. Two or three drops of the preparation should be placed on a little cotton wool, which, if possible, should be tied over the wound, so keeping the air away. Care should always be taken to see that the sting is not left in the flesh. That of the bee almost always is and keeps on injecting its poison.

Other remedies are a solution of ammonia and bicarbonate of soda made into a paste with water and vinegar.

Wounds.

For systematic study wounds may be classed according to their direction, or depth, or locality, but for our purpose they may be arranged after the mode of their infliction: (1) Incised wounds, as cuts or incisions, including the wounds where portions of the body are clearly cut off; (2) punctured wounds, as stabs, pricks or punctures; (3) contused wounds, which are those combined with bruising or crushing of the divided portions; (4) lacerated wounds, where the separation of tissue is effected by or combined with the tearing of them; (5) poisoned wounds, including all wounds into which any poison, venom or virus is injected.

Any of these wounds may be attended with excessive hemorrhage or pain or the presence of dead or foreign matter. As all wounds tend to present several common features, a few words will be said about these before describing the distinctive characteristics of each.

The first is *hemorrhage* (bleeding). This depends, as to quantity, upon several conditions, the chief of which is the size of the blood-vessels divided and to some extent upon the manner in which it has been done. A vessel divided with a sharp instrument presents a more favorable outlet for the escape of blood than one that has been divided with a blunt or serrated instrument or one that has been torn across. Except in the first named, the minute fringes or roughness necessarily left around the edges of the vessel at the point of division retard the escape of blood and furnish points upon which deposits of blood, in the shape of clots, can take place. Hence, all other things being equal, an incised wound is usually attended with more hemorrhage than a contused or lacerated wound.

The bleeding may be simply an oozing from the smallest blood-vessels, called the capillaries. This form of bleeding is not of much consequence and can easily be checked.

The bleeding may be from a vein and is then called venous. The veins are the largest vessels which carry the blood back to the heart. The blood from them is purple and flows evenly, without any force.

The bleeding may be from an artery and is then called arterial. The arteries are large distributing vessels which carry the blood from the heart to the extremities. The blood from them is bright red and flows in pulsations or jets with some force. This is the most dangerous form of bleeding and the hardest to control.

While we are not able sometimes to ascertain the kind of hemorrhage from a given wound, we should always try to determine it, for there may be considerable difference in the treatment.

There is always some pain present in a wound, and this varies largely with the location and extent of the injury. Often it is not nearly so much as we expect to find.

In wounds of large size there is some shock, and when the wound is very extensive and crushing the state of shock may be profound, even to unconsciousness. In some people the mere sight of blood may be enough to cause fainting. This, of course, is very different from shock and much easier to treat.

Nature stops bleeding by causing the blood to coagulate in little clots, which plug up the open mouths of the divided blood-vessels and prevent the further flow of blood. The smaller the blood-vessel and the more sluggish the current of blood therein, the more quickly this is done. Therefore this coagulation occurs first in the capillaries, next in the veins and last of all in the arteries. All that we can do is to aid nature in this by making the current of blood flow more slowly or by making the mouths of the vessels smaller.

If the wound is small and the bleeding mostly capillary oozing, the part should be elevated, and firm pressure applied directly to the wound, preferably through a clean wet cloth. A few minutes of this will usually be sufficient. If this does not suffice, we can try again, or we can apply water just as hot as can be borne without scalding, or we can apply pressure with a piece of ice wrapped in a clean handkerchief or a thin cloth. Heat and cold contract the blood-vessels and pressure not only does this, but retards the current of blood.

If the bleeding is from a small vein, the above treatment will usually suffice. If the vein is larger, the pressure may have to be applied for some time. To do this roll up a handkerchief or clean cloth into a small, hard wad, wet it thoroughly and then bind it firmly over the wound by means of another handkerchief or a strip of cloth. It may have to be kept on for some hours before the clots in the vessels are strong enough. The pressure should be sufficient to check the bleeding entirely. If the bleeding is from a small artery, the above measures will often be enough, but if the artery is of any size these alone will not do.

If the wound is evidently not severe, and the bleeding moderate, take time to move the patient to a quiet, comfortable place (if not already in such a one) and then attend to the bleeding.

If the wound is a severe one and the hemorrhage free, *act at once*, and remember that the first and most easily applied means of stopping bleeding is *direct pressure in the wound*, and that the best and easiest tools to use are those which you always have with you—namely, *your own fingers*.

Put your finger or fingers on the bleeding point in the wound, and press firmly, and keep them there until you or some one else gets ready to do something further in the care of the case. You are stronger than the heart, and so long as you press on the open end of a blood-vessel, the heart cannot pump blood out of it.

We should try to be as *clean* as possible in all our handling of wounds, and therefore if you have time to do so, and if, for instance, you are in or near a drug store, where you can get aseptic gauze, put some of it over your fingers before putting them into the wound; or, if you cannot get gauze, but have a clean, unused handkerchief, use that; but if you have nothing clean at hand, use your fingers as they are and *stop the bleeding*. If the bleeding is moderate and you can get some gauze, as mentioned above, do not put your finger into the open wound at all, but pack the gauze in tightly and then press firmly on the gauze or put a bandage tightly over it and the wound.

CHAPTER II

AGRICULTURE

BRIEF SCHEME OF CLASSIFICATION

MISCELLANEOUS FORMULAS
BUTTER
CHEESE
FERTILIZERS
MILK
POULTRY
VETERINARY FORMULAS
WEEDS

The subject of Insecticides is so important that it has been made a separate chapter in connection with pests of all kinds. Attention is called to the fact that the Department of Agriculture issues important agricultural literature for a low price and many of the publications are free. Address the Department of Agriculture, Washington, D. C. Any reasonable questions will be answered free of charge.

MISCELLANEOUS FORMULAS.

Apples.

The utilization of the poorer grades of fruit is frequently an important matter to the grower. That portion of a crop which is of too low grade to market in the ordinary way can often be made to pay a large part, at least, of the expense of maintaining the orchard or fruit plantation if it is converted into some other form or handled in some way other than that practiced with the better grades. In some of the apple-growing districts the evaporating industry has kept pace with the planting of orchards and has become an important factor in the utilization of the fruit which is unfit or would prove unprofitable for marketing in the fresh state.

Farmers' Bulletin 291, issued by the United States Department of Agriculture, entitled "Evaporation of Apples," by H. P. Gould, gives very valuable information on this subject.

Birdlime.

Boil the middle bark of the holly, gathered in June or July, for 6 or 8 hours in water, until it becomes tender; then drain off the water and place it in a pit under ground, in layers with fern, and surround it with stones. Leave it to ferment for two or three weeks, until it forms a sort of mucilage, which must be pounded in a mortar into a mass and well rubbed between the hands in running water until all the refuse is worked out; then place it in an earthen vessel and leave it for four or five days to ferment and purify itself. **Remarks**: Birdlime may also be made from mistletoe berries, the bark of the wayfaring tree and other vegetables by a similar process. Should any of it stick to the hands, it may be removed by means of a little oil of lemon bottoms or turpentine. *Use.* To rub over twigs to catch birds or small animals. It is said to be discutient when applied externally.

Branding Stock, Ink for.

Shellac, 2 oz.; borax, 2 oz.; gum arabic, 25 oz.; water, 25 oz.; lampblack, sufficient. Boil the borax and shellac in the water until dissolved. Remove the mixture from the fire and, when cool, add the gum arabic and sufficient water to make 25 ounces. Then add enough lampblack to bring the whole to a proper consistency. For red ink use Venetian red instead of lampblack, for blue use ultramarine.

Grafting Wax.

1.—T. Tidmarsh recommends in *The Gardeners' Chronicle* the following mixture: Beeswax, 1 part; rosin, 3 parts. Melt together. For use, remelt in a glue pot, the water jacket of which will retain it in a workable consistency for a considerable time and also prevent it from being overheated to a point dangerous to the scions. For hot climates the proportion of rosin should be increased to 4 to 1 of wax.

2.—Yellow wax, 6 parts; rosin, 10 parts; turpentine, 30 parts; lard oil, 1 part.

3.—Black pitch, 10 parts; white pitch, 10 parts; Burgundy pitch, 10 parts; rosin, 10 parts; fatty varnish, 4 parts; red lead, 4 parts; alcohol, 8 parts. Put the varnish and the red oxide of lead in a glazed earthenware vessel of sufficient size to avoid accidents from bubbling over, mix them well and then add the rosin broken into small pieces. Melt them over a very gentle fire and stir continually. When fusion is complete, remove from the fire and add the alcohol little by little, with constant stirring. When all the alcohol is incorporated pour the product into well tinned boxes and seal for preservation until wanted for use.

4.—Melt slowly 500 parts by weight of Burgundy rosin; remove from the fire and stir in 70 to 80 parts of 90 per cent. alcohol. Keep in wide-necked glass vessels or tin cans.

5.—10 parts of rosin, 1 of turpentine, 4 of alcohol. Stir in the alcohol last.

6.—35 parts of rosin, 25 of yellow wax, 15 to 20 of alcohol.

7. Clay tempered with water, to which a little linseed oil is sometimes added. Used to cover the joint formed by the scion and stock in grafting.

8.—*Tree Wax, Liquid.*—The *Pharmaceutische Centralhalle* gives the following formula for tree waxes that remain liquid in the cold: 1—Pine rosin, 70 parts; yellow ceresin, 7 parts; wood alcohol, 35-40 parts. Melt together the rosin and ceresin and add the alcohol with proper precautions. 2—Rosin, 60 parts; yellow wax, 8 parts; hard paraffin, 8 parts; Venice turpentine, 5 parts; wood alcohol, 40 parts. Mix as above directed.

Hay.

Two hundred and seventy cubic feet of new meadow hay and 216 to 243 feet from large or red stacks will weigh a ton; 297 to 324 cubic feet of dry clover will weigh a ton.

Haystacks, Covering for.

Take any coarse fabric, steep it for a few hours in a strong aqueous solution of alum, dry and coat the upper surface with a thin covering of tar.

Labels, to Preserve.

1.—*Wooden.*—The following method of preserving wooden labels that are to be used on trees or in exposed places is recommended: Thoroughly soak the pieces of wood in a strong solution of sulphate of iron; then lay them, after they are dry, in lime water. This causes the formation of sulphate of lime, a very insoluble salt, in the wood. The rapid destruction of the labels by the weather is thus prevented. Bast, mats, twine and other substances used in tying or covering up trees and plants, when treated in the same manner,

are similarly preserved. At a meeting of a horticultural society in Berlin wooden labels thus treated were shown which had been constantly exposed to the weather during two years without being affected thereby.

2.—*Zinc.*—For zinc plates use with quill pens only.

a.—Dissolve muriate of ammonia and crude sal ammoniac in strong vinegar.

b.—For large labels, dip your pen in concentrated sulphuric acid and write on the zinc, previously greased; a sharp point of copper wire is better than the pen; quench in water; wash thoroughly from fluid when your writing is plain enough.

c.—Dissolve about 75 cents' worth of chloride of platinum in hot distilled water, adding a very few drops of aqua regia. The liquid should be of a pale amber color; enough for hundreds of labels.

d.—Common lead pencil on zinc labels is almost indelible and becomes more distinct with age.

e.—Chloride of platinum solution, and better, sulphate of copper, may be used, and are perhaps somewhat more distinct.

Mushrooms.

Use an old bureau or chest of drawers as a cultivating bed. Fill the drawers to the depth of six or eight inches with an intimate mixture of good, rich soil and old, dry horse or cow dung in equal parts. Procure some fresh mushroom spawn (the French is the best) and insert it at various points on the surface of the soil. Sprinkle (not too heavily) the surface, and the beds are ready. If the drawers close tightly in front, the back of the stand should be removed and a curtain tacked up in such a manner as to shut out the light. The mushrooms will begin to show themselves plentifully in a few days, but it will be a fortnight before any fit to eat can be gathered. The bed will last, with an occasional watering, for many months and furnish almost daily a good mess of champignons.

Potatoes in Cellars and Pits, to Prevent from Rotting.

On the ground on which the tubers are to be piled spread a thin layer of unslaked, finely pulverized lime, then a layer of potatoes six inches deep, then lime again, and so on. The tubers thus treated remain free from disease and where rotting has already commenced it is stopped.

Trees.

Coating for Amputated Branches and Wounds.—1.—Shellac, dissolved in alcohol, forms an excellent coating for amputated branches and for wounds of fruit trees, making a water-proof artificial skin, under which the wood grows until the wound is healed.

2.—The following cement is used to protect injured trees: 2 parts of yellow ocher; wood ashes (sifted), 1 part; white lead, 10 parts; Venice turpentine, 2 parts; linseed oil, q. s. to mix.

BUTTER

Classification.

Butter Making.
Coloring Butter.
Deterioration of Butter.
Preserving Butter.

Butter Making.

The following directions for butter making are obtained from Farmers' Bulletin 241, entitled "Butter Making on the Farm," by E. H. Webster, M. S.

It is needless to say that all the milk utensils should be kept scrupulously clean. There should be no hidden places in milk vessels. Wooden vessels should not be tolerated under any condition for holding milk, for it is impossible to keep them clean. A little ordinary sal soda and a little borax is a cheap and effective cleansing agent. A brush should be used in preference to a cloth. The final rinsing of dairy vessels should be in boiling hot water. The milk should not be allowed to stand in a barn after it is drawn, as it readily absorbs odors. It should not be placed in a cellar or cave where there are decaying vegetables or fruits, as it will quickly absorb the odors from them. Full instructions for using the milk separator will be found in the pamphlet to which we refer. Detailed information relative to the operation of separators comes with each machine.

Up to the time of ripening the cream the dairyman has been trying to keep it as free as possible from bacteria and to check the growth of all that may get into it, but from this point on the work will be quite different. Cream prepared with the aid of a separator should be perfectly sweet, and if cooled properly will remain so for a number of hours, and in fact it can be preserved for four or five days if kept at a temperature of 50°F. It may be churned in this condition and the quality of the butter made that is in demand in a limited way, but, practically speaking, all butter used in this country is churned from sour cream. Sweet cream butter to most users tastes flat and insipid.

The trouble with ordinary souring is that it may not be the desirable kind. It must be handled in such a way that desirable flavors will be developed and the undesirable ones kept in check. This can only be accomplished with a perfectly sweet cream and afterward controlling the souring process. This control is secured by introducing into the cream what is known as a "starter," which is nothing more nor less than nicely soured milk either whole or skimmed. It will contain those varieties of bacteria which will develop the flavors wanted and not those which cause putrefaction, gassy fermentation and similar undesirable changes. To secure a starter containing suitable bacteria the dairyman has simply to set away a portion of skim milk as it comes from the separator. If the milk is kept at a temperature of 70 to 80°F. it should sour within twenty-four hours and form a solid curd. A test of this curd shows whether or not the dairyman has kept his milk clean. If the taste is found pleasant and mildly acid, and the curd readily breaks when poured from one vessel to another, he has a good starter. On the other hand, if the curd is stringy and will not break with a square, sharp cleavage, but seems to be granular, or if a clear whey is found on the surface, it shows that bacteria of a harmful species are present. If the souring continues too long too much acid is formed, the starter becomes sharp and unfit for use. A glass jar is the best vessel in which to make a starter, as the glass is easily cleaned and the butter maker can see what action is taking place while the milk is souring.

If there are gas-producing germs in the milk little bubbles will form in the bottom and along the sides of the jar. If these are formed the starter should not be used as the effect will not be good.

If one is churning every day, about 1 to 1½ gal. of starter to 10 gal. of cream is the right proportion. If the cream is cooled to about 60°F. it will require more starter than if it is set at 70°F. If the cream is not to be churned every day, but must be held from two to four days before enough is secured for churning, a small amount of starter may be added to the first batch of cream or the cream may be held sweet from two to four milkings and the starter added in a larger quantity.

Whole milk can be used for a starter instead of skim milk, but it is considered better to use the latter. The surface of the starter should be skimmed off for one-half inch in depth and thrown away. This is to prevent the possibility of dust and the formation of colonies of undesirable bacteria. There are various types of churns, the barrel churn being one of the best. In this form of churn the concussion of the cream necessary to do the churning is secured by the falling of the cream as the churn is revolved. The faster it is revolved the greater the number of concussions per minute will be secured. If the churn is whirled too fast the centrifugal force created holds the cream from falling so that no churning takes place. Wooden churns should be kept scrupulously clean.

The process of churning is the gathering into a mass the butter fats of the cream. Butter fat exists in the cream in minute globules, each independent of the others, and any agitation tends to bring them together, the force of the impact causing them to adhere to each other. As the agitation is continued these small particles of butter grow larger by the addition of other particles until a stage is reached where they become visible to the eye, and if the churning is continued a sufficient length of time all will be united in one lump of butter in the churn. If the cream is quite warm the butter will come very quickly; if it is too cold the churning may be prolonged for a considerable period. It is usually considered that about 30 to 35 minutes' churning should bring the butter. This time will be varied somewhat according to the temperature of the different seasons. It is necessary in hot weather to churn at a temperature as low as 50 or 55°F., while in the winter months, when the cows are on dry feed and the weather is cold, it is often necessary to raise the churning temperature to 60 or 65°. It is important to know at just what point to stop churning. The butter granules should be the size of beans or grains of corn, possibly a little larger. The churning is then stopped and the buttermilk allowed to drain. After the buttermilk is well drained from the butter granules an amount of water about equal in volume and of the same temperature as the buttermilk should be added and the churn given four or five revolutions slowly, so that the water will come in contact with every particle of butter and wash out the remaining buttermilk. As soon as the wash water is drained from the butter granules salt should be added, depending upon the demands of the consumer. Usually one ounce of salt for each pound of butter is all that will be required. In the ordinary barrel churn the salt may be added in the churn. By giving the churn a few revolutions the salt will be quite thoroughly incorporated with the butter. It should be allowed to stand for a few minutes until the salt becomes more or less dissolved before working of the butter is begun.

For working butter some form of table should be used. The old bowl and paddle will never give good results, because the butter will be greasy owing to the sliding motion of the paddle over the butter. If the salt and butter have been mixed in the churn the butter can be placed on the working table and the working begun at once.

After the butter has been pressed out with the roller it should be divided in the center, one part being laid over onto the other and the rollers passed over again. The process should be repeated until the butter assumes what is termed a waxy condition. If the working is continued for too long a time the butter will become salvy, having the appearance of lard, and will lose its granular structure, becoming weak-bodied. The firmness of the butter must be taken into account in determining how long it should be worked.* Usually the firmer the butter the more working it will stand and the more time it will need to thoroughly incorporate the salt and bring out the waxy condition.

Testing Saltiness While Working.—During the process of working, the butter should be tested frequently to determine its saltiness, and if by mistake too much salt has been added it can readily be removed from the butter by pouring a little cold water over it as the working continues. The water washes out the excess of salt. If the butter should contain too little salt, more can readily be added during the process of working. It is best practice to about half finish the working and then let the butter stand for about twenty minutes or half an hour before completing. This gives the salt an additional chance to dissolve and there is less liability of mottles in the finished product.

Mottles, Remedy for.—If after standing a few hours the butter is found to show a mottled appearance, this can be overcome by putting it on the worker and giving it an additional working. The mottled appearance indicates that some step in the working of the butter has not been thoroughly done. It is due to an uneven distribution of salt and possibly to the presence of casein that has not been washed from the butter, the action of the salt on the occasion forming lighter spots in the butter. The best remedy for mottles is to thoroughly wash the butter when it is in granular form before the salt is added and then to work it until it has reached the waxy condition alluded to.

Butter in Tubs.—If the butter is to be put up in tubs, the packing should be so done that the butter will be solid throughout its entire mass. Too frequently the butter is thrown in without sufficient packing and large holes will appear in the body of the butter. While these may not affect the quality they affect the appearance. If a parchment paper lining is used in the tub it should be put in smooth and the top should be turned neatly over the edge of the butter. Coverings that are put on the top, whether circles of parchment or cloth made for the purpose, should exactly fit the top of the package. Care should be taken that the tub does not show finger marks or other dirty spots.

Butter in Small Packages.—It is becoming more common for the markets to demand that butter be packed in small packages, such as pound prints or squares. Butter put up in this form should be neatly wrapped in parchment paper. It is an excellent idea for the dairyman to have his name or label printed on the parchment. This helps to establish the identity of the goods, which, if properly made, should aid the dairyman in finding a permanent market for them. Wooden packages of almost any size can be secured for packing the prints. These should be used, particularly if it is necessary to ship the butter to market. For local distribution light crates or boxes which will fit the prints and prevent them from getting out of shape in hauling should be used.

Refrigerator Boxes.—In the summer months it is a hard matter to transport butter from the dairy to the market and keep the prints in shape, unless the dairyman has ice for this purpose. Light refrigerator boxes are manufactured which can be used to great advantage, as their use will keep the butter hard and firm and enable the maker to deliver it in that condition to his customers in the hottest weather. No one likes to buy a parcel of butter that is so soft that it can hardly be handled, and the good dairyman will not attempt to place butter on the market in that condition.

The Bureau of Animal Industry, U. S. Department of Agriculture, publishes as Circular No. 56 "Facts Concerning the History, Commerce and Manufacture of Butter," by Harry Hayward.

Other information may be obtained from Farmers' Bulletins, Nos. 84, 92, 131, 201, 237, 349 and 381. The entire subject is being gone into by the Department of Agriculture and the bulletins may be obtained, when completed, from that source.

Coloring Butter.

1.—Use a little annatto; if pure it is not injurious.

2.—The coloring matters commonly employed are annatto and turmeric or extracts of these, but there are also a number of butter-coloring compounds or mixtures sold for this purpose. For some of these it is claimed that they will not only impart the desired color to butter, but will keep it sweet and fresh for an indefinite time. The following are a few of these coloring compounds in use at present. Rorick's compound is prepared as follows: The materials for 1,000 lb. of butter are: Lard, butter or olive oil, 6 lb.; annatto, 6 oz.; turmeric, 1 oz.; salt, 10 oz.; niter, 2-5 oz.; bromochloralum, 3½ oz.; water, q. s. The lard, butter or oil is put into a pan and heated in a water bath. The annatto and turmeric are then stirred into a thin paste with water, and this is gradually added to the fatty or oily matters kept at a temperature of about 110°F. The salt and niter are next stirred in and the mixture heated to boiling. The heating is continued for from twelve to twenty-four hours or until the color of the mixture becomes dark enough. The bromochloralum is then introduced and the mass is agitated until cold, when it is put up in sealed cans.

3.—Bogart's preparation is prepared as follows: The materials employed are: Annattoin, 5 oz.; turmeric (pulverized), 6 oz.; saffron, 1 oz.; lard oil, 1 pt.; butter. 5 lb. The butter is first melted in a pan over the water bath and strained through a fine linen cloth. The saffron is made into a ½ pt. tincture, and, together with the turmeric and annattoin, is gradually stirred into the hot butter and oil and boiled and stirred for about fifteen minutes. It is then strained through a cloth as before and stirred until cool.

4.—Dake's butter coloring is prepared by heating a quantity of fresh butter for some time with annatto, by which means the coloring matter of the butter is extracted, and straining the colored oil and stirring it until cold.

5.—The following is commended in a German agricultural journal: Alum, pulverized finely, 30 parts; extract of turmeric, 1 part. With the extract dampen the powder as evenly as possible, then spread out and dry over some hot surface. When dry again pulverize thoroughly. Protect the product from the light. As much of the powder as will lie on the point of a penknife is added to a churnful of milk or cream before churning, and it gives, says the authority on the subject, a beautiful golden color, entirely harmless. To make the extract of turmeric add 1 part of powdered turmeric to 5 parts of alcohol and let macerate together for fully a week.

6.—Ethereal extract annatto, 1 oz.; oil (olive or cottonseed), 100 oz.

7.—Purified annatto, powdered, 10 oz.; oil, 100 oz. Digest for two hours in a steam or water bath, allow to stand for one week, then decant. Of either of the above liquids 6 drops added to 1 quart of cream is sufficient.

8.—Annattoin, 5 av.oz.; powdered turmeric, 6 av.oz.; true saffron, 1 av.oz.; odorless lard oil, 16 fl.oz.; alcohol, 4 fl.oz. Rub the annattoin and turmeric with the oil, which may be deodorized by filtration through charcoal and macerate for several days. Prepare a tincture with the alcohol and saffron. After a sufficient maceration separate the solids from the oil by filtration, adding more oil through the filter, to keep the measure, and mix the tincture of saffron with this, driving off the alcohol by a gentle heat.

Of late coal-tar dyes are being largely introduced for the same purpose. They are mostly azo dyes and are sold specifically as butter dyes. However, they are not recommended.

9.—*Odorless Coloring.* — Annatto, ½ oz.; sodium bicarbonate, 1½ oz.; sugar, 8 oz.; potassium nitrate, 8 oz. Soften the annatto with about 2 oz. water, using the heat of a water bath. Stir in about 2 oz. of the sodium bicarbonate, evaporate to dryness and mix with the remainder of the soda and the other ingredients.

10.—MacEwan, in his "Pharmaceutical Formulas," states that vegetable annatto is being replaced by aniline orange, the following being recommended as a popular coloring: Oil-soluble aniline orange, 1 oz.; olive oil, 160 fl.oz. Dissolve the color in the oil by gentle warming. Cottonseed oil may be used in place of olive oil. A teaspoonful of the coloring is sufficient for 10 gal. of cream.

Deterioration of Butter.

Butter fat, and therefore butter, is very unstable and it is therefore very liable to deterioration which, if it continues, renders it unfit for food. The butter loses color; it develops a tallowy taste and odor. As the deterioration progresses the texture changes from a firm or a solid to a pasty mass. When this stage is reached it is fit only for soap grease.

Butter may be kept stored at a low temperature and in a dark place from six to eight months. To protect butter which is shipped to tropical countries it is often made from preserved cream and packed in hermetically sealed cans.

While butter cannot be prevented from deteriorating without the use of chemicals, which is forbidden under the Pure Food Law, much can be done to retard this deterioration by handling it in all stages of its production under the most cleanly condition, by preserving the cream with which it is made by guarding it against infection, by packing it in air-tight packages and holding it at low temperatures or in darkness.

Butter that is put in packages of greater size than the brick or print form will hold its flavor longer than the smaller packages. Prints and pats which are pleasing to the eye must be uncommonly well wrapped so as to make an almost air-tight package. Glass or glazed earthenware butter jars should be used in all households.

Substitutes for Butter.

At the present time there are three commercial substitutes for butter. These are oleomargarine, butterine and renovated butter. These are subject to special examination by the Government and are subject to special taxes. The laws relating to their manufacture are most rigid. For information as to the processes of the manufacture of oleomargarine the readers are referred to the SCIENTIFIC AMERICAN supplement numbers.

Butterine is oleomargarine with which is mixed more or less butter. This is a purely commercial term and is not recognized by law. All "butterine" is legally oleomargarine.

"Renovated butter" is made from lots of butter which have been subjected to a process by which it is melted, clarified and refined for the purpose of removing rancidity or any deleterious flavors, or of otherwise improving the rendering uniform miscellaneous lots of butter which could not find a profitable market without being subjected to some such process of renovation.

The purpose of the Government surveillance is to see that regulations are observed whereby no unwholesome material or process is used so that the purchaser or consumer is advised of the true character of this kind or grade of butter.

Home Test for Butter.

The following home test for butter is from Farmers' Bulletin 131 of the Department of Agriculture: The experiment may be conducted in the kitchen as follows: Using an ordinary coal-oil lamp as a source of heat, melt a piece the size of a small chestnut taken from the suspected sample in an ordinary tablespoon, hastening the process by stirring with a splinter of wood (a match will do). Then increasing the heat, bring to as brisk a boil as possible, and, after the boiling has begun, stir the contents of the spoon thoroughly, not neglecting the outer edges, two or three times at intervals during the boiling, always shortly before the boiling ceases. Oleomargarine and renovated butter boil noisily, sputtering more or less, as a mixture of grease and water would naturally behave when boiled, and produce no foam or but very little. Renovated butter produces usually a very small amount of foam. Genuine butter ordinarily boils with less noise and produces an abundance of foam. The difference in regard to foam is, as a rule, very marked. A butter is rarely found which yields an uncertain result, but if uncertain it should be considered genuine butter or a case of suspicion not confirmed.

Circular No. 100 of the Bureau of Animal Industry, Department of Agriculture, gives a rapid method for the determination of water in butter, by C. E. Gray.

Preserving of Butter.

1.—The best method to preserve butter from the air is to fill the pot to within an inch of the top and to lay on it common coarse-grained salt, to the depth of ½ an inch or ¾ of an inch, then to cover the pot up with any flat article that may be convenient. The salt by long keeping will run to brine and form a layer on the top of the butter, which will effectually keep out the air and may at any time be very easily removed by turning the pot on one side. Fresh butter, 16 lb.; salt, 1 lb.; fresh butter, 18 lb.; salt, 1 lb.; saltpeter, 1¼ oz.; honey or fine brown sugar, 2 oz.

2.—*Appert's Method.*—Take fresh butter of the best quality and press it through a clean cloth in order to make it as dry as possible. Then cut it into small pieces and pack closely into glass jars, leaving no vacant spaces. Close the jars with cork stoppers, seal hermetically and fasten with wire in addition; put into cold water and heat to the boiling point. Butter thus treated will keep in a cool place for six months.

3.—*Breon's Method.*—Put fresh butter into tin cans, under a thin layer of water containing tartaric acid and sodium carbonate. Fill up the cans with the liquid and solder on the covers.

4.—*Melted Butter.*—Butter may be melted directly over the fire or in a water bath (*bain-marie*). In the first case put it into a copper kettle and set over a clear, moderate fire. Any impurities will sink to the bottom or rise to the top in froth. Stir slowly and skim off the froth as it forms. When no more rises, cool to 50 to 60°C. (122 to 140°F.) and pour into earthen jars with narrow necks. When the butter has hardened put a layer of salt over the top and close tightly with paper. The best way of melting is in the water bath; that is, with the vessel containing the butter placed in another with boiling water. It is a good plan to strain the melted butter through a cloth. It will keep unchanged for a year, but is good only for cooking.

5.—*Pickled Butter.*—Wash the semi-salted butter thoroughly and spread out in a thin layer on a moist table. Work into it 60 grams (6 parts by weight) of fine salt to each kilogram (100 parts) of butter. Pack the butter into earthen jars and set in a cool place for a week; then, if there is any vacant space in the jar, fill it up with salt brine. If the butter is to be sent away, pour off the brine and put in a layer of dry salt. This salted butter has a good flavor and can be used for the table. Cut it out from the jar in horizontal pieces, smooth off the surface each time and fill the space with brine.

6.—*Preserving Paper.*—Cooking salt, in fine powder, 160 gr.; saltpeter, in fine powder, 320 gr.; whites of 20 eggs. Beat the albumen to a froth, mix the salts and add the mixture to the froth, little by little, with constant stirring, until a solution is formed. In this soak a good quality of bibulous paper and hang it across strings to dry. When dry go over each sheet with a hot smoothing iron, the face of which is kept well waxed.

Rancid Butter, To Sweeten.—1.—100 lb. of butter is mixed with about 30 gal. of hot water, containing ½ lb. of bicarbonate of soda and 15 lb. of fine granular animal charcoal free from dust, and the mixture is churned together for half an hour or so. The butter is then separated, after standing, warmed and strained through a linen cloth, then resalted, colored and worked up with one-half its weight of fresh butter.

2.—Rancid butter may be restored, or at all events greatly improved, by melting it with some freshly burnt and coarsely powdered animal charcoal (which has been thoroughly freed from dust by sifting) in a water bath and then straining it through clean flannel. A better and less troublesome method is to well wash the butter with some good new milk and next with cold spring water. Butyric acid, on the presence of which rancidity depends, is freely soluble in fresh milk.

3.—One authority advises to wash the butter first with fresh milk and afterward with spring water, carefully working out the residual water. This, even if effective, will cost about as much time and material as to convert the milk into fresh butter.

4.—Another recipe says to add 25 to 30 drops of lime chloride to every 2 pounds of butter, work the mass up thoroughly, then wash in plenty of fresh, cold water and work out the residual water.

Butter, To Clarify.—Put the butter into a stewpan, heat it slowly, removing the scum as it rises, and when quite clear, pour it carefully into clean and dry jars, leaving the sediment behind.

Curled Butter.—Tie a strong cloth by two of the corners to an iron hook in the wall. Tie the other end of the cloth into a knot, but so loosely that the index finger may be easily passed through it. Place the butter in the cloth, twist it lightly, thus forcing the butter through the knot in fine short rolls or curls. The butter may then be garnished with parsley and served. Butter for garnishing hams, etc., should be worked until sufficiently soft, and then used by means of a piece of stiff paper folded in the form of a cornet. The butter is squeezed in fine strings through the hole at the bottom of the cornet, and a little experience soon enables the worker to execute various designs.

Fairy or Feathery Butter.—Work the butter until it is sufficiently soft, then place it in a piece of coarse butter muslin or some loosely woven fabric through which it can be forced in fine particles and which must be previously wetted with cold water. Draw the edges of the muslin together and press the butter gently through, letting it fall lightly into the dish in which it will be served or round any dish it is intended to garnish.

Molded Butter.—Butter may be shaped without the aid of molds, but round butter molds or wooden stamps are much used and are made in a variety of patterns. They should be kept scrupulously clean, and before the butter is pressed in the molds should be scalded and afterward well soaked in cold water. The butter at once takes the impress of the mold and may therefore be turned out immediately into the butter dish. In hot weather a little ice should be placed either round or beneath the butter dish. Dishes with a double bottom are constructed for this purpose.

CHEESE

The following notes on cheese making are obtained from Farmers' Bulletin 166, entitled "Cheese Making on the Farm," by Henry E. Alvord. This subject is being revised by the Department of Agriculture and may be obtained from that source when completed. In the meantime Farmers' Bulletins 84, 92, 97 and 237 contain valuable information.

The ordinary process of which American cheese is made in factories is not applicable to the farm dairy, because it takes too much time and is so complicated that it requires years of practice to become sufficiently familiar with the varying conditions in which milk comes to the vat. The various changes that take place in milk and which are troublesome in making cheese nearly all develop in the night's milk kept over until the following morning. So if milk is made into cheese immediately after it is drawn, no difficulty need be experienced. By employing a simple and short method of manufacture any one at all accustomed to handling milk can, with the appliances found in any well-regulated farm home, make uniformly a good cheese.

Double Cream Cheese.—This is the most popular cream cheese in Paris and it is said that about 40,000 are consumed daily in that city. It is also called Swiss cream cheese. According to Pourian, it is made as follows:

Ten pounds of cream and 64 pounds of new milk are mixed carefully and brought to a temperature of 55 to 57°F. Enough diluted rennet extract is added to make it coagulate in twenty-four hours. The curd is cut into flat pieces with a skimmer and laid on a linen cloth, which is folded over it so as to form a sort of press bag. These bags or packages are laid in a perforated box with boards between them, and when the first flow of whey stops the top board is loaded with a weight of some kind. This pressing takes sixteen to eighteen hours, as a rule; it should continue until whey ceases to escape.

The curd is then spread on a large table and worked and kneaded by hand, while adding enough cream to give it a uniform smooth consistency; after this it is left on the table some hours to become firmer.

The moulding may be done by taking in the right hand enough curd to make a cheese, placing it on a piece of paper and rolling it into a small cylinder. If many of the little cheeses are to be made, a suitable molding apparatus should be provided, which may be constructed substantially as follows: A form, or mold, is made by taking an open tin box or pan of a depth corresponding to the length of the cheeses to be made, the bottom of the pan or box having a convenient number of circular openings into which tin cylinders of the desired dimensions have been soldered. To form the cheeses this mold is placed bottom uppermost on a sheet of perforated tinned steel somewhat larger than the mold and supported by short feet, so that it may stand on a table. By the aid of a wooden piston each cylinder may be lined with a roll of paper. The curd is then dumped on top of the mold, pressed into the cylinders and struck off smoothly with a piece of board. The whole "form" is then lifted carefully, leaving the cheeses in their paper wrappings on the perforated tin plate. They are then ready to be packed for the market.

This cheese, as analyzed by Pourian, has 55 per cent. water, 30 per cent. fat and 15 per cent. casein, etc. One dozen weigh about 2 pounds.

(These descriptions of Neufchatel and cream cheese are taken from J. H. Monrad's book, entitled "The A B C of Cheese Making.")

English Cream Cheese.—Very thick cream is poured carefully into a linen bag and this hung up, with a basin underneath to catch the whey, in a cool room or cellar. The air in the room must be pure, as the cream easily absorbs odors. When the whey is partly drained off the bag is twisted tight and bound so as to dry the curd more; then, after twenty-four to forty-eight hours, according to temperature and the consistency of the cream, the "cheese" is ready to eat, and may be molded as desired. This is hardly cheese, as no rennet is used. Perhaps it should be called a "sour cream curd."

French Cream Cheese.—Enough rennet is added to the morning's milk, set in a jar at a temperature of 70°F., to coagulate in two or three hours, and then left for twenty or twenty-four hours. Instead of any special mold, a common hair sieve may be used. After pouring out the whey gathered on top of the curd, cut the latter into slices with a skimmer and lay it in the sieve to drain. When well drained, add cream in quantities to suit, but not more than that from a quantity of milk equal to that first coagulated. Mix the curd and cream by mashing with a wooden pestle, like a potato masher, until a uniform paste is obtained. This is then placed in wicker molds or baskets lined with muslin. In France heart-shaped molds are made for the purpose. The cheese is used when freshly made. If it is to be kept several days an ice-box will be necessary.

Neufchatel Cheese.—The fresh morning's milk, while still at a temperature of about 90° F., is set in a stone jar holding 40 pounds or less, and enough rennet is added to coagulate it in about twenty-four hours. It should stand in a room of about 60° F., and a reliable rennet extract should be used. The jar may be covered with a woolen blanket or the like to keep the temperature uniform. When coagulated the whole mass is poured into a piece of cheese cloth, which is either placed in a basket or hung up on four supports fixed for that purpose. It is then left twelve hours to drain. Then the cloth is gathered together around the curd and placed in a square wooden box with perforated bottom and sides and a press-board put on with weights; a few stones will answer or a small lever press may be used. The curd is pressed for twelve hours and then kneaded by hand on dry cloth into a uniform stiff paste. It requires experience to get exactly the right consistency. If it is too moist, new dry cloths are placed under it, and it is worked until dry enough. But if too dry, it is a sign that either too much rennet has been used or the curd has been pressed too much. In this last case some new curd is added and carefuly mixed with the other. When of the right consistency it is put into small molds. Little tin cylinders are usual, of 2¼ inches diameter and 3 inches high. Any little tin can may be used by unsoldering the top and bottom. After smoothing both ends the cylindrical-shaped cheese is pushed out and salted by strewing on both ends and lightly rolling between the hands covered with salt.

The little cheeses are then placed on any kind of a draining board and left for twenty-four hours. If made in any quantity a drying room should be prepared with lath shelves, on which smooth, dry straw is placed, and the cheeses laid upon the straw without touching each other. They are turned often enough to prevent loss of shape or sticking to the straw. Many people prefer this cheese while quite fresh, and it may be used at any time after being dried for a day. But if more age and maturity are preferred, more time and attention are required, with special conditions.

Left upon the straw, white mold may be expected to appear after five or six days. Leave this undisturbed and in ten or fifteen days more the mold becomes blue and the cheeses are then said to have their "first skin." They should then be taken to a cool and rather moist cellar with similar shelves, placed on end on the straw and turned every three or four days. After three or four weeks in this place, red spots begin to appear, and the cheese, being then from six weeks to two months old, is considered to be at its best. It takes 6 pounds of milk for 1 pound of cheese.

Instead of straw, wooden mats or "splashers" may be used on which to dry the cheese.

This cheese is the kind commonly sold in this country wrapped in tinfoil. Some of that in the market is very poor, being made from skim milk, and is in reality nothing but cottage cheese, although sold under this French name.

Notes for Home Cheese Making.

Utensils.—A good vat—one that can be kept clean and sweet and large enough to hold whatever milk is to be used at one time. A press, for the product of from five to eight cows, a simple lever with weights. Accompanying the press must be hoops; a good size is 10 inches in diameter and 8 inches deep, made of heavy tin, edges strong and no top or bottom. A drainer or vessel with perforated bottom, in which the curd is drained; a large basket will do, lined with strainer cloth. A dozen cloths a yard square. A thermometer. A curd knife or knives. These come in pairs, one to cut horizontally and one vertically, but a long, slim knife will do or a strong piece of galvanized wire netting, or even a strong strip of tin. A suitable room for curing, with a few smooth, wide shelves on which to cure the cheese.

Rennet.—Use about one tablespoonful of rennet extract for 3 gallons of milk. If the curd is over one-half hour in coming, increase the quantity of rennet; if less, decrease it. Rennet tablets may be used.

Preparation of the Curd.—Warm the milk to 85° F., add the rennet and mix thoroughly, then cover and let stand at this temperature for about one-half hour, or until the curd will break, leaving the whey clear. Then cut each way, leaving it in columns about 1 inch square. Now let it stand until the whey rises an inch on top of the curd, then warm the whole gradually, taking two or three hours to reach 98° F., lifting and stirring and breaking it gently with the hand all the time until the pieces are about the size of grains of corn. Be very careful not to crush the curd, as that will cause the cream or fat to escape with the whey. Then let stand at this temperature, stirring it occasionally to keep from packing, until the curd is so firm that when squeezed gently in the hand and the hand opened, it will separate into particles again. The whey should have a slightly acid taste. Then dip the curd into a basket lined with cloth to cool and drain.

Salt.—Salt the curd after it is drained, using 4 ounces of salt to 10 pounds of curd, mixed in carefully but thoroughly; or salt by brine bath or rubbing, after pressing.

Pressure.—The pressure must be gentle at first or the milk fat will run out, thus leaving a poor cheese. Increase the pressure gradually, and in a few hours take the cheese out, turn it, rearrange the bandage and press as before.

Curing.—This is a very important part of cheese making. The room for curing (and it may be in a basement or cellar if the conditions are right) should be, first of all, capable of being kept at an even and medium temperature. From 50 to 60° F. is now regarded as the best for domestic purposes, although the time in curing may be somewhat lengthened thereby. The cooler the room the slower the curing. If the room at any time gets much warmer than 65°, even for a short period, the cheese is likely to be permanently injured. The room should be fairly dry, but not too dry, and, while being well ventilated, should be free from currents of air. If too dry or subjected to dry currents, the cheese will lose weight and be apt to crack. Great care must be taken to keep out all flies. The bandage should be greased and rubbed and the cheese turned over on the shelf every day or two for a month; later this need be done only once or twice a week. If the cheese should crack, paste strips of cheesecloth or stout paper over the openings.

Information on Cheese Making Processes, its Chemistry, etc., is contained in our Scientific American Supplement, Numbers *1245, 1493, *1642, 1643 and 1647.

For particulars about the Scientific American Supplement kindly refer to the Advertising Pages.

FERTILIZERS

1.—A cheap fertilizer consists of sulphate of ammonia, 60 lb.; nitrate of soda, 40 lb.; ground bone, 250 lb.; plaster, 250 lb.; salt, ½ bushel; wood ashes, 3 bushels; stable manure, 20 bushels. Apply the above amount to six acres. Labor in preparing included, it costs about $15. It is said to give as good results as most of the commercial fertilizers costing $50 per ton.

2.—*Artificial Manures.* — a. — (Anderson.) Ammonium sulphate, common salt and oil of vitriol, each 10 parts; potassium chloride, 15 parts; gypsum and potassium sulphate, each 17 parts; saltpeter, 20 parts; crude Epsom salts, sodium sulphate, 33 parts. For clover.

b.—(Huxtable.) Crude potash, 28 lb.; common salt, 1 cwt.; bone dust and gypsum, each 2 cwt.; wood ashes, 15 bushels. For either corn, turnips or grass.

c. — (Johnstone.) Sodium sulphate (dry), 11 lb.; wood ashes, 28 lb.; common salt, ¾ cwt.; crude ammonium sulphate, 1 cwt.; bone dust, 7 bushels. As a substitute for guano.

d.—*Liquid Manure.*—(1.) Dissolve 25 lb. guano in 5 gal. of water. For use add 2½ oz. of this solution to 5 gal. water.

(2.) Sheeps' dung, ⅓ peck to 15 gal. of water; sulphate of ammonia, ⅝ oz. to every gallon.

e.—*Manure from Soot.*—Save the soot that falls from the chimneys when the latter are cleaned. Twelve qt. soot to 1 hhd. water makes a good liquid manure, to be applied to the roots of plants.

3.—*Chemical Guano* (Grandeau).—Calcium nitrate, 100 parts; potassium nitrate, 25 parts; potassium phosphate, 25 parts; magnesium sulphate, 25 parts. Dissolve from 4 to 10 grams of this powder in 1 liter of water, and water each pot plant with this once or twice a month. The plants must be in full vegetation.

4.—*Fish Fertilizers.*—The fish fertilizers on the market have much less value than natural fertilizers, like guano. The reason is that the material obtained from fish is poorer in soluble nitrates and phosphates than the natural guano, and that it is in an imperfect state of division. M. J. Carstairs claims that fish contain all the elements of the best guano, and its inferior value is due to the loss produced in the manufacture. He has adopted the following method of preparation, consisting essentially in submitting the fish, dried and reduced to pieces, in an appropriate extractor, to the action of a mixture, in the state of vapor, of a solvent of the oil or a mixture of such solvents.

The solvents, according to him, may be classed in three groups; Group A: Carbon bisulphide, ether, benzol, benzoline, etc. Group B: Ethylic or methylic alcohol or a mixture of these. Group C: Acetone, etc.

The role played by the substances of Group A is well known. Alcohol, at the temperature at which it is vaporized, converts the soluble albuminoids into insoluble albuminoids, and thus prevents them from mingling with the oil, to the detriment of its quality and its nutritive value as a fertilizer.

The action of alcohol has as a result the solidification of the albuminoids, which otherwise would be converted into a jelly, so that the fish, freed from the oil and taken from the extractor, are brittle and may be reduced to any state of division desired by means of an apropriate machine.

On the other hand, acetone, although this has in itself but a slight dissolving power for animal fats, considerably increases the action of the solvents, even when it is employed in small quantities.

The proportion of the mixture to be employed depends on the special substances of Groups A and B. When benzoline and methylic alcohol are made use of, the most suitable proportion is benzoline, from 80 to 85; alcohol, 12 to 15; acetone, 3 to 5.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT, from *La Revue des Produits Chimiques.*

Cheap Fertilizer from Fish.—Pass fish refuse through mincing machine and expose in layers 3 in. deep in a kiln heated to 300° F. until properly dried.

5.—*Fertilizing Powder.*—Bone dust, 9 parts (very fine); plaster paris, ½ part; sulphate ammonia, ½ part. Steep the seed in the drainings of a dunghill; drain, but while still wet sprinkle with the powder and dry.

Fertilizers for Special Purposes.

Corn.—To produce 50 bushels more than the natural product to the acre use:

1.—Nitrogen, 64 lb., in the form of sulphate of ammonia;

2.—Potash, 77 lb., in the form of chloride of potash;

3.—Phosphoric acid, 31 lb., in the form of muriate of superphosphates.

To grow 1 ton of hay to the acre more than the natural product use;

4.—Nitrogen, 36 lb., in the form of sulphate of ammonia;

5.—Potash, 31 lb., in the form of chloride of potash;

6.—Phosphoric acid, 12 lb., in the form of superphosphate.

Cotton. — Ammonia, 2.50 per cent.; available phosphoric acid, 7.50 per cent.; potash 4 per cent.

Fruit Trees.—Potassium chloride, 100 parts; potassium nitrate, 500 parts; potassium phosphate, 570 parts. This total amount of 1,170 grams to be used for one tree.

Garden Plants.—1.—Sugar, 1 part; potassium nitrate, 2 parts; ammonium sulphate, 4 parts.

2.—Ferric phosphate, 1 part; magnesium sulphate, 2 parts; potassium phosphate, 2 parts; potassium nitrate, 2 parts; calcium acid phosphate, 8 parts. About a teaspoonful of either of these mixtures is added to a gallon of water and the plants sprinkled with the liquid.

3.—Ammonium sulphate, 10 parts; sodium nitrate, 15 parts; ammonium phosphate, 30 parts; potassium nitrate, 45 parts.

Lawns.— 1. — Potassium nitrate, 30 parts; sodium nitrate, 30 parts; calcium sulphate, 30 parts; calcium superphosphate, 30 parts.

2.—Ashes strewn on lawns prevent the growth of moss and promote that of the grass. Soot, which is often thrown away, is an excellent fertilizer, particularly for grass, onions, potatoes and all kinds of radishes. Both ashes and soot have the property of keeping away sand fleas and little snails. An excellent fertilizer is obtained by mixing nine parts of soot with one of salt.

Oats.—To produce 25 bushels of oats and the usual proportion of straw per acre more than the natural product of the soil, and in proportion for other quantities, use:

1.—Nitrogen, 10 lb., in the form of sulphate of ammonia.

2.—Potash, 31 lb., in the form of chloride of potash;

3.—Phosphoric acid, 8 lb., in the form of superphosphate.

To produce 1,500 lb. of dried leaf tobacco with the usual proportion of stalk-more than the natural yield per acre of land, use:

4.—Nitrogen, 149 lb., in the form of sulphate of ammonia;

5.—Potash, 172 lb., in the form of sulphate of potash;

6.—Phosphoric acid, 16 lb., in the form of superphosphate;

7.—Lime, 160 lb., in the form of sulphate of lime (lime plaster).

These mixtures should be sown over the land broadcast when the ground is well prepared, before planting, and not put in the hills, so that the roots may seek the food and not concentrate and thereby cause the plants to burn up.

Orange Fertilizer.—Ammonia, 3.25 per cent.; available phosphoric acid, 3.50 per cent.; potash, 14.50 per cent.

Potatoes.—To produce 100 bushels of potatoes per acre and their usual proportion of tops more than the natural proportion of the land, and other quantities proportionally, use:

1.—Nitrogen, 21 lb., in the form of sulphate of ammonia;

2.—Potash, 34 lb., in the form of sulphate of potash;

3.—Phosphoric acid, 11 lb., in the form of superphosphate.

Potted Plants and Flowers.—1.—A plant, in order to thrive properly, must grow in a soil that furnishes the necessary inorganic matters as food. If these are not present, or present only in small quantity, the plant either dies, or grows scantily, or develops only certain portions of its structure. Thus grain grows only small and undeveloped seeds if the soil does not contain enough phosphoric acid. As regards the organic food, plants are less dependent on the soil, as this is derived directly or indirectly from the atmosphere. As plants vary in the kind of mineral matter required, and the available mineral constituents in the soil also differ greatly in different localities, it is often necessary for the proper development of certain plants to add certain substances to supply the deficiency. Some plants require principally one kind, some another, as lime, silica, potash or salt. Experiments on vegetation have shown that a plant will thrive perfectly when the lacking substances are supplied in a

suitable form—*e.g.*, in the following combinations: 1. Calcium nitrate, potassium nitrate, potassium phosphate, magnesium phosphate, ferric phosphate (sodium chloride). 2. Calcium nitrate, ammonium nitrate, potassium sulphate, magnesium phosphate, iron chloride (or sulphate) (sodium silicate).

It is well known that in nature nitrates are formed wherever decomposition of organic nitrogenous substances takes place in the air, the ammonia formed by the decomposition being oxidized to nitric acid. These conditions for the formation of nitrates are present in nearly every cornfield, and they are also the cause of the presence of nitrates in water that has its source near stables, etc. In Peruvian guano nitrogen is present partly in form of potassium nitrate, partly as ammonium phosphate and sulphate. In form of nitrate it acts more rapidly than in form of ammonia, but in the latter case the effect is more lasting. Phosphoric acid occurs in guano combined with ammonia, potash and chiefly with lime, the last being slower and more lasting in action than the others.

2.—Potassium nitrate, 30 parts; potassium phosphate, 25 parts; ammonium sulphate, 10 parts; ammonium nitrate, 35 parts. Where flowers are blooming or where blooming is to be promoted, the application of ammonium nitrate alone is recommended.

3. Ammonium chloride, 2 parts; sodium phosphate, 4 parts; sodium nitrate, 3 parts; water, 80 parts. Mix and dissolve. To use, add 25 drops to the quart of water, and use as in ordinary watering.

4.—Ammonium nitrate, 40 parts; ammonium phosphate, 20 parts; potassium nitrate, 25 parts; ammonium chloride, 5 parts; calcium sulphate, 6 parts; iron sulphate, 4 parts.

5.—Ammonium sulphate, 30 grams; sodium chloride, 30 grams; potassium nitrate, 15 grams; magnesium sulphate, 15 grams; magnesium phosphate, 4 grams; sodium phosphate, 6 grams. One gram to be dissolved in 1 liter of water and the flowers watered up to three times daily. Dissolve 4 grams in 1 liter of water and water with this solution daily.

6.—Potassium chloride, 12.5 grams; calcium nitrate, 58 grams; magnesium sulphate, 12 grams; potassium sulphate, 15 grams; iron phosphate, recently precipitated, 2.5 grams. This turbid mixture (1.16 or 1 gram in 1 liter) is used alternately with water for watering a pot of about 1 liter capacity; for smaller or larger pots in proportion. After using the amount indicated, the watering is continued with water alone.

7.—Sodium chloride, 10 parts; potassium nitrate, 5 parts; magnesium sulphate, 5 parts; magnesia, 1 part; sodium phosphate, 2 parts. Mixed and bottled. Dissolve a teaspoonful daily in a liter of water and water the plants with the solution.

8.—Sodium phosphate, 4 oz.; sodium nitrate, 4 oz.; ammonium sulphate, 2 oz.; sugar, 1 oz. Use two teaspoonfuls to a gallon of water.

9.—Saltpeter, 5 parts; cooking salt, 10 parts; bitter salt, 5 parts; magnesia, 1 part; sodium phosphate, 2 parts. Mix and fill in bottles. Dissolve a teaspoonful in 1 liter (about a quart) of hot water and water the flower pots with it each day.

10.—Ammonium nitrate, 40 parts; ammonium phosphate, 50 parts; potassium nitrate, 90 parts. Two grams of this fertilizer suffice for a medium-sized flower pot.

11.—Ammonium sulphate, 10 parts; sodium chloride, 10 parts; potassium nitrate, 5 parts; magnesium sulphate, 5 parts; magnesium carbonate, 1 part; sodium phosphate, 20 parts; 1 teaspoonful to 1 liter of water.

12.—Ammonium nitrate, 40 parts; ammonium phosphate, 20 parts; potassium nitrate, 25 parts; ammonium chloride, 5 parts; calcium sulphate, 6 parts; ferrous sulphate, 4 parts. Make doses of 2 grams each, which are dissolved each in 1 liter of water and use the solution for watering the potted plants.

13.—Potash niter, 20 parts; potassium phosphate, 25 parts; ammonium nitrate, 35 parts; ammonium sulphate, 10 parts. Through this mixture a luxurious foliage is secured. If it is desired to act more on the flowering the ammonium nitrate must be omitted.

14. Ammonium sulphate, 30 parts; sodium chloride, 30 parts; potash niter, 15 parts; magnesium sulphate, 15 parts; magnesium phosphate, 4 parts; sodium phosphate, 6 parts. Dissolve 1 gram in 1 liter of water and apply three times per day.

15.—Calcium nitrate, 71 parts; potassium chlorate, 15 parts; magnesium sulphate, 12.5 parts; potassium phosphate, 13.3 parts; freshly precipitated ferric phosphate, 3.2 parts. A solution of 1 gram of this mixture is applied, alternating with water, to the plants. After using a certain quantity, pour on only water.

16.—Ammonium phosphate, 300 parts;

sodium nitrate, 250 parts; potassium nitrate, 250 parts, and ammonium sulphate, 200 parts, are mixed together. To every liter of water dissolve 2 grams of the mixture and water the potted plants once a week with this solution.

17.—Potash niter, 20 parts; calcium carbonate, 20 parts; sodium chlorate, 20 parts; calcium phosphate, 20 parts; sodium silicate, 14 parts; ferrous sulphate, 1.5 parts. Dissolve 1 gram of the mixture in 1 liter of water.

18.—Calcium nitrate, 100 parts; potassium chlorate, 30 parts; potassium phosphate, 30 parts; magnesium sulphate, 20 parts; ferrous sulphate, 0.1 part. Dissolve 2 grams of the solution in 1 liter of water.

19.—Dissolve potash niter, 100 parts; ammonium phosphate, 100 parts, and phosphoric acid, 2.5 parts, in 1,000 parts of ordinary syrup. For 1 liter of water add at most 10 cubic centimeters and apply this solution, alternating with ordinary water. For Cactaceae, Crassulaceae and similar plants, which do not directly assimilate organic substances, distilled water should be used instead of syrup. Chlorotic plants should be coated with dilute solution of iron, or else iron should be admixed to the soil, whereupon they will become green again. The iron is absorbed in the form of ferric chloride or ferrous sulphate.

Vegetables.—The formula for the vegetable fertilizer varies with the kind of vegetable which is cultivated: Ammonia, 5 to 7 per cent.; available phosphoric acid, 6 per cent.; potash, 8 to 12 per cent.

Fertilizers: Artificial, Their Nature and Function. Ammonia, Fixation of Atmospheric Nitrogen, are treated of in our Scientific American Supplement, Numbers 1439, 1490, 1608, 1640, 1641, 1642, 1643, 1644, *1668, 1685, *1740, 1675, *1748, *1784, 1787.

* Indicates illustrations of plant for atmospheric nitrogen production. For particulars about the Scientific American Supplement kindly refer to the Advertising Pages.

MILK

Much depends upon the health of the herd, the cleanliness of cows and their surroundings, the construction and care of utensils, and the health, cleanliness and milking methods of employes. For a full description of proper methods, including a description of bacteria and conditions affecting bacterial growth see Farmers' Bulletin No. 63, issued by the United States Department of Agriculture.

Artificial Milk.

Humanized Milk.—1.—White of egg, 150 parts; fresh oil sw. almonds, 350 parts; milk sugar, 400 parts; sodium carbonate, 4 parts; neutral calc. phosph., 25 parts; water, enough to make 1,000 parts. Mix and make an emulsion.

2. New milk, 12 pt.; cream, 16 oz.; milk sugar, 13 oz.; water, 8 pt. Dissolve the sugar of milk in the water and mix with the other ingredients. Fill bottles to the shoulder, place in a kettle surrounded with water and place on the fire. Allow the water to boil for thirty minutes, then cork and allow the boiling to continue for another half hour, when sterilization will be complete.

3.—Harold Stacey says: To reduce the content of casein in cow's milk to the same percentage as that of human milk it is necessary to add three parts of water to every five parts of milk. The fat and milk sugar are naturally diminished, and the requisite percentage must be made up by addition of more milk sugar and fat. The latter is added either in the form of cream or butter, preferably the latter, owing to its more constant composition. It is readily emulsified by the milk. The following forms a good working formula: New milk, 2 pt.; fresh butter, 3 drams; milk sugar, 500 gr.; water, 19 oz. Dissolve the milk sugar in the water and add to the milk and butter previously emulsified.

4.—If cream be used the following formula, given by Prof. Clague, will be found to work well: New milk, 3 oz.; cream, 1¾ oz.; milk sugar, 1⅛ oz.; water, 18 oz. Mix.

Buttermilk, Artificial.

The cooling and grateful effects of buttermilk are so highly appreciated in the hospitals of Paris, that, in the absence of the fresh article, the physicians have devised the following formula for the preparation of an artificial substitute for the genuine article: Buttermilk powder (see below), 10 parts; vinegar, 1 part; syrup of buckhorn, 1 part. Dissolve the powder in the water and add the vinegar and syrup.

The powder is prepared as follows: Sodium chloride, 50 parts; milk sugar, 100 parts; potassium nitrate, 5 parts; alum, 5 parts. Mix.

Condensed Milk.

The process of "condensing" milk consists in evaporating the greater portion of the water present, and, if to be kept definitely, sugar is added as a preservative. The quantity of sugar used varies in the different brands. Hager gives the results of the analyses of five different samples of good Belgian condensed milk, none of which vary much from the following: Milk sugar, 15.58 per cent.; cane sugar, 33 per cent.; fat, 8.25 per cent.; albumin, 17.96 per cent.; salts, 1.95 per cent.; water 23.20 per cent. The following description of the operation of condensing milk in the way indicated is taken from an early issue of the *Circular:*

"The milk, as it is received, is run into square vats some four or five feet above the level of the bath and heating room. The bath tubs are circular, have a coil of steam pipe at the bottom and are nearly filled with water. In this bath are set cans, each holding about forty quarts. The milk is run into these cans from the receiving tanks and is heated to from 150 to 175°F. It is then drawn thence into the heating wells, which have jacketed steam bottoms, and is there heated to boiling. It is next run into the vacuum pan, into which a stream is kept flowing about as fast as the evaporation goes on. If the milk is to be preserved plain, without the addition of sugar, it is evaporated to about one-fourth its volume, and as soon as the vacuum is broken the temperature is raised to about 200°F. The vacuum pan is kept at about 140°F. If the sugar is to be added, the hot milk from the vacuum pan is run into pans containing the requisite quantity of sugar which is dissolved."

Cream.

The following information relative to cream is taken from Farmers' Bulletin 42, United States Department of Agriculture:

When it is desired to raise cream the milk should be put in a cold place, where it will not be disturbed, as soon as possible after it is received. A good quality of cream for table use can usually be obtained in this way. It will aid the cream in rising if the temperature of the milk is raised to about 100°F. and then lowered by placing the dish in cold water. This cannot be done unless the milk is in good condition, as the high temperature may cause it to sour before it will cool sufficiently to prevent souring. Milk jars or bottles are now extensively used, and if they are filled when the milk is fresh, and carefully handled, the cream will show plainly within a few hours, and much less time is required for it to reach the top after it has been delivered than when it has been mixed just previous to delivery. Thus by the use of the jars considerable time is saved and fresher cream can be obtained. The jars may be purchased from any dairy supply company at a small cost, and provide a neat, clean way of handling milk.

Separator cream can be made much richer than "gravity" cream, and for this reason is preferred for whipping and some other purposes. It may be kept longer, as it can be taken from perfectly fresh milk, while that raised by gravity is usually 12 to 24 hours old when skimmed. Cream gradually becomes thicker the longer it is kept, and it is often held for this purpose. Sometimes it is 1 or 2 weeks old when used; very little is used in as fresh condition as milk. For this reason special care is needed to keep it sweet. Satisfactory results are not obtained by placing it in a refrigerator at a temperature of 50°F. It ought to be kept as near the freezing point as possible; it should be placed directly in contact with the ice or, better yet, be entirely surrounded with ice. Good efforts will be wasted if the ice comes up only half way and the top part is exposed to a warm temperature—it must be cold throughout. Skimmed milk and buttermilk should have the same care as whole milk.

Dried Milk.

Dried milk is one of the most recent results of food industry. It is a yellowish powder, presenting the appearance of coarse rye flour. According to the manufacturers, it gives a product resembling fresh milk when mixed with water in proper proportions. Chemical analysis shows that the water is reduced from about 88 to about 3 per cent. in this powder. Its composition is as follows:

Total solid matter, 95 per cent.; albumen, 25 per cent.; fat, 24 to 25 per cent.; ash, 5.7 per cent.; milk sugar, 40 per cent.

It represents ten times its weight of fresh milk and may be used advantageously in coffee, cocoa, etc.

Milk Powder Manufacture is treated of in our Scientific Supplement No. 1553. For particulars about the Scientific American Supplement kindly refer to the Advertising Pages.

Pasteurization of Milk.

The following information relative to the pasteurization of milk is taken from

Farmers' Bulletin 43, issued by the United States Department of Agriculture:

The practice of pasteurizing milk is being followed by some dealers who find that it greatly reduces the number of complaints they receive on account of sour milk. The treatment consists of heating the milk to a temperature, usually between 140 and 160°F., at which large numbers of bacteria in the milk are killed, and then cooling it to check the growth of others. If sufficient heat were used to kill all the germs the product would be called sterilized milk, and it might be kept in good condition indefinitely. Unfortunately the higher heat renders milk objectionable to most consumers, by changing its taste and appearance, and perhaps slightly reducing its nutritive value.

Special kinds of apparatus are used for pasteurizing milk on a large scale, and those generally preferred by the dealers are called continuous pasteurizers because they do their work continuously. They are arranged so that the milk to be pasteurized flows through the apparatus in an uninterrupted stream, being heated by passing in a thin layer over a metal surface on the opposite side of which is steam or other heating agent, and being cooled in a similar manner in the same apparatus or another close at hand. Care is taken not to allow the temperature to go so high that a disagreeable cooked flavor is produced.

The pasteurization of milk is desirable when the milk contains large numbers of harmful bacteria, and especially when it is thought to contain some pathogenic or disease-producing bacteria.

The importance of doing the work thoroughly cannot be overstated. The temperature must be high enough and must be retained long enough to kill disease-producing organisms such as those of typhoid fever. Care must be taken to avoid scorching milk, and it must be thoroughly cooled and protected from contamination after being heated.

Some persons go so far as to advocate the pasteurization of all market milk in plants controlled by the municipalities. But there are objections to the process as well as advantages, and it is doubtful if it should be adopted except where special need exists. An important objection is that some of the worst types of bacteria are not killed by pasteurizing temperatures, and these grow in the pasteurized milk whenever the temperature permits. Furthermore, they grow more rapidly in pasteurized than in raw milk, because the "sour-milk" organisms, which would be antagonistic to them and hold them in check, have been largely destroyed by the heat. Thus it is possible for objectionable and even dangerous changes to take place in pasteurized milk without being apparent, and a consumer may use highly contaminated milk without knowing it until bad effects are caused. He is warned against common souring which takes place in raw milk by the appearance, taste and smell of the milk. Some of the strongest champions of pasteurization recognize this objection and advise that it be done not more than twenty-four hours before the milk is consumed, so as to avoid the possibility of extensive bacterial changes without accompanying warning signs as described.

The pasteurization of milk in the home is an easy operation, and mothers should know how to do it, as the necessity may arise at any time. Of course it is best to have clean, wholesome milk that does not need to be pasteurized, but sometimes this is impossible and the only milk available for the little ones is from unknown sources and is teeming with bacteria. Undoubtedly such milk has cost many young lives. It is estimated that one-third of all children die before they are 3 years old, and one of the leading causes of infant mortality is unwholesome milk. Bad milk cannot be made perfect by pasteurization, but the danger from its consumption can be lessened. The Department of Agriculture has issued circulars giving full directions for pasteurizing milk in small quantities. The process is simple and the necessary apparatus is inexpensive.

Briefly the directions are as follows: One or more bottles nearly full of milk are plugged with dry absorbent or other clean cotton and placed in an upright position in a vessel having a false bottom and containing enough water to rise above the milk in the bottles. The vessel is closed, placed on the stove and heated until the water is 155°F., or even to boiling if special precautions are deemed necessary. It is then removed and kept tightly covered for half an hour. A heavy cloth over the vessel will help to retain the heat. The milk bottles are then taken out, cooled as quickly as possible by cold water or ice, and kept in a cold place. Milk thus prepared may be expected to keep twenty-four hours, and should preferably be used within that time. The cotton plugs should be kept as dry as possible and should not be removed until the milk is to be used. A covered tin pail answers well for the larger vessel. An inverted pie pan with perforated bottom can serve as the false bottom. A hole may be punched in the cover of the pail, a cork inserted, and a chemical thermometer put through the cork so that the bulb dips in the water, thus enabling one to watch the temperature closely without removing the cover, or an ordinary dairy thermometer may be used from time to time by removing the lid.

Preservation of Milk.

1.—A mixture of 2 drams boracic acid with 3 drams common salt, of which an addition of 2-3 dram to 1 gal. of milk is said to increase its keeping qualities for twenty-four hours.

2.—When milk contained in wire-corked bottles is heated to the boiling point in a water bath, the oxygen of the included small portion of air under the cork seems to be carbonated, and the milk will, it is said, keep fresh for a year or two.

3.—A small quantity of boracic acid added to milk will keep it from souring and delay the separation of cream. It can be kept several days by this means.

4.—Fresh milk in bottles has been treated with oxygen and carbonic acid under pressure of some atmospheres. By this method it is said to be possible to preserve milk 50 to 60 days in a fresh state. The construction of the bottles is siphon-like. A bacteriological examination of the preserved milk is still out.

5.—Engineer Budde, of Copenhagen, has discovered a preserving agent for milk which consists in adding to the milk, which should be as fresh as possible, enough hydrogen peroxide to cause it to be completely decomposed by the enzymes of the milk. For this purpose 1.3 per cent., by volume, of a 3 per cent. hydrogen peroxide solution is required. The milk is well shaken and kept for five hours at 50 to 52°C. in well-closed vessels. Upon cooling, it is said to keep fresh for about a month and also retain its natural fresh taste. With this process, if pure milk is used, the ordinary disease germs, it is claimed, are killed off soon after milking and the milk sterilized. For still longer conservation Budde adds another harmless preserving agent which he keeps secret, as it has not yet been patented.

6.—*Glacialine.*—According to Dr. Besana, this substance, which has met with so much favor in England and elsewhere as an antiseptic, especially for the preservation of milk, has the following composition: Boracic acid, 18 parts; borax, 9 parts; sugar, 9 parts; glycerine, 6 parts.

7.—*Morfit's Process.*—In 1 gal. milk at 130 to 140°F. (55 to 60°C.) is dissolved 1 lb. gelatine; the mixture is left to cool to a jelly, when it is cut into slices and dried. The compound is used to gelatinize more milk, and this is repeated till the gelatine is in the proportion of 1 lb. to 10 gal. of milk.

Testing Milk.

The following directions for detecting impure milk, including the use of the creamometer, lactometer and the Babcock test, is taken from Farmers' Bulletin 42, issued by the United States Department of Agriculture:

By pure milk is meant the properly handled product of healthy, well-fed cows. To be legally regarded as pure, in most places, milk must contain at least a certain amount of fat and other solids. It is a difficult thing to determine by the appearance of milk whether it is pure or not, and even experienced dairymen are frequently unable to do this. It has a slightly yellowish white color, a very slight odor, if any, and should have a distinctly sweet and pure taste. When allowed to stand quietly for several hours, cream should rise naturally, and if the separation is thoroughly effected the cream should form one-eighth to one-fifth of the total volume or bulk. No sediment should appear in the bottom of the jar or vessel. When good milk is poured from a tumbler it should cling to the glass a little and not run off clean like water. Skimmed or watered milk is thinner than whole milk and of a lighter shade, being of a bluish-white color. The yellow shade of milk is chiefly due to its fat, but as this constituent is more yellow in the milk of some cows than others the yellowest milk is not necessarily the richest, and it is unsafe to judge by the color alone; poor milk from some cows may be more highly colored than rich milk from others. Besides this, artificial colors are sometimes added by dishonest persons.

When a quantity of milk is to be tested, the first and most important thing to be done is to obtain a fair sample—one that will represent the whole and show its average composition. If the sample is taken from near the top or bottom of a vessel of milk which has been standing quietly for even a short time, it will be too rich or too poor in fat. The milk must be well and thoroughly mixed before the sample is taken. A good way of doing this is to pour it several times from one vessel to another. This should be continued until no lumps or collections of cream appear on the surface. If small particles of butter are floating about, a fair sample cannot be taken. There are several methods of testing milk. A complete analysis by a chemist will give the exact amount of each component part. This requires considerable time and expense, and is not necessary for practical purposes.

Babcock Test.—1.—Several methods of rapidly determining the fat content of milk with the aid of chemical reagents have been devised. One of the most accurate is the Babcock milk test.[*] The little machine constructed to apply this test, and of which several patterns are made, is in use in almost all well-conducted milk-receiving stations. It requires about a tablespoonful of milk for a sample, and the exact percentage of fat in it can be determined by this test in ten to fifteen minutes. The result is obtained by the action of centrifugal force aided by some chemical agents. The original cost of the machine is from $4 to $15, according to size and pattern, and less than 1 cent's worth of materials are used for each sample. Its manipulation is easily learned, and it can be successfully operated by any careful person. A definite amount (18 grams[†]) of the milk or cream to be tested is measured in a pipette and placed in a bottle which has a long, slender, graduated neck (Fig. 1). Sulphuric acid is then added, and the bottle shaken until the mixture becomes dark-colored, which requires but a few moments. The acid does not affect the fat, but it dissolves the other milk solids which keep the fat globules apart.

The bottle is then placed in the machine, by which it is rapidly revolved in a horizontal position with the neck toward the center. The fat is thus forced toward the neck by the other contents of the bottle, which are heavier and therefore thrown away from the center to the bottom of the bottle. Sufficient warm water is added to bring the fat up into the neck, where its exact percentage can be read on the scale. In the illustration a pipette for measuring the milk, the acid measure and a test bottle are shown. From two to twenty-four bottles, containing as many different samples, can be tested at a time, according to the size of the machine. Special bottles of a modified form are furnished for testing skimmed milk and cream. Apparatus for this test is sold by dairy supply firms. A small machine, complete with the necessary glassware and acid, can be obtained for $5 or $6. Full directions are sent with the apparatus. These can be easily followed and quite accurate results obtained after a little practice.

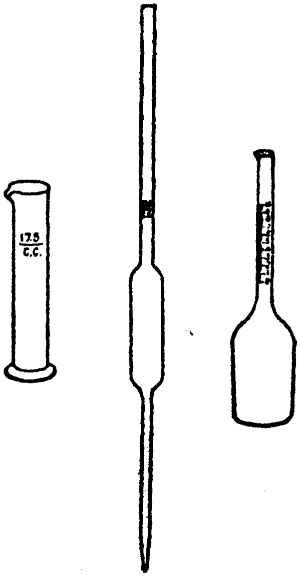

Fig. 1.—Glassware for the Babcock Milk Test.

A number of other tests which can be quickly and easily made have been described by different investigators. Like the Babcock test, they are for the determination of the fat only, but are less satisfactory. Some testing appliances have been placed on the market with the necessary chemical agents in bottles designated by a letter or number, without information as to the character of the liquids. These have to be used without sufficient knowledge of their nature, and they are apt to be unduly expensive. Ether is sent out in this way. This is not safe, as considerably damage might result from an inexperienced person handling such a highly inflammable or explosive substance.

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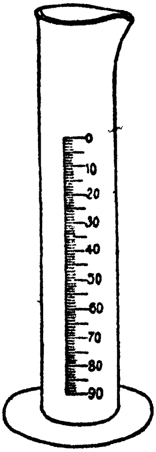
[*] Invented by Dr. S. M. Babcock, of the Wisconsin Agricultural Experiment Station, and fully described in bulletins of that and several other experiment stations.

[†] 17.6 c.c. of milk weighs practically 18 grams. Cream is lighter than milk; hence a larger volume must be taken. For exact results, cream samples should be weighed.

2.—*Creamometer.*—A very simple test, and one which, although not altogether reliable, is better than none, is the judgment of milk by the amount of cream it will show. This is not an accurate test, because it may fail to show cream when it should or it may show more than it ought. However, it will not show cream if there is none in the milk. With two samples of milk having the same amount of fat different results may appear with this test, as the proportion of the fat globules which rise depends on certain conditions, including the size of the fat globules, the age of the milk, and the way it was handled before delivery. If fat globules have much difficulty in rising, only a small part of them will get to the top and they may carry up with them so much of the other constituents that there will be a large bulk of poor cream. When the test is carefully conducted and conditions are favorable to the rise of cream, fair results can usually be obtained. This test requires a long, graduated glass tube (Fig. 2), which is filled with milk to the zero mark and allowed to stand in a cool place for twenty to twenty-four hours. The cream may be aided in rising by warming the milk to 100° F. and then setting it, in the tube, in cold water, or the tube may be filled half full of milk and the remainder with warm water, which raises the temperature and reduces the viscosity; in such case only half as much cream will appear as the milk is to be given credit for; for example, if the contents of a glass are half water and show 10 per cent. cream upon the scale, this means, of course, 20 per cent. of the milk. If the milk is the same each day and is tested in the same way, there should be little difference in the cream shown. Tubes graduated specially for this test are sold by dairy supply firms. The cream test furnishes a good opportunity to look for sediment; if the milk is not clean, dirt can be seen in the bottom of the cylinder. Care should be taken to carry the tube quietly, so that neither the cream nor the sediment will be disturbed.

3.—*Lactometers.*—Milk is a little heavier than water. Its specific gravity varies from 1.029 to 1.033, which means that the weight of pure milk varies from 1.029 to 1.033 times the weight of water. Departures from the standard weight, such as those due to the quality of the natural milk or to skimming or watering, can be measured by an instrument called the lactometer. This is a weighted glass bulb with a slender stem bearing a graduated scale, and it is so adjusted that when placed in pure milk it will sink until some point on the scale is even with the surface of the liquid. This point is called the reading. Different kinds of lactometers are graduated in different ways. A style frequently used and known as the board of health lactometer registers 100 when the specific gravity is 1.029, and less than 100 when the specific gravity is less than 1.029. A specific gravity of 1.033 would be indicated by 114 on this lactometer.



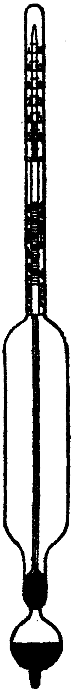


Fig. 2.—Creamometer.
Fig. 3.—Lactometer.

The Quevenne lactometer is graduated from 15 to 40 and indicates directly the specific gravity. Thus at 60°F. it would read 32 in milk having a specific gravity of 1.032 and it would read 30.5 in milk having a specific gravity of 1.0305. The best forms of lactometers have a thermometer in the stem above the lactometer scale so that the temperature of the milk can be taken at the moment the reading is recorded. If the temperature is above or below 60°F. the lactometer reading must be corrected, and with the Quevenne lactometer the correction is made by adding 0.1 to the readnig for each degree of temperature above 60° or subtracting 0.1 for each degree of temperature below 60°. Thus, if the Quevenne lactometer reading is 31 in milk having a temperature of 56°, the corrected reading would be 30.6 and the specific gravity at 60°, 1.0306.

Accurate as these instruments are, they cannot do more than show specific gravity. If cream, which is lighter than milk, is removed, the specific gravity is increased; and if water is added, the specific gravity is decreased. Therefore if a sample of milk has a high specific gravity, skimming is suspected; while if it has a low specific gravity, watering is suspected. But if some cream is removed and water is added in proper proportion, the specific gravity may remain unchanged; and this is one of the commonest ways of all for adulterating milk. If such fraud is extensively practiced it can be detected by the creamometer test or, more surely, by the Babcock fat test.

A fair opinion of the value of milk, so far as its composition is concerned, can be formed from the percentage of fat, as the total solids of normal milk increase and decrease as the amount of fat is greater or less. If milk has been tampered with by watering, the percentage of fat is reduced in the same proportion as the other constituents, but in a greater proportion if the milk is skimmed. As fat is the part that the dishonest person tries to abstract, the purchaser is on the safe side if he judges of the quality of the milk by the fat which it contains. Many tests for the fat of milk have been proposed. The lactoscope and other optical methods are sometimes used to determine the fat or "oil," but they are inaccurate, and especially so in the hands of one without large experience. Some of them depend on the color of the milk or on the fact that the more fat there is, the less light will pass through a thin layer. But as the color of milk is not an indication of its richness, and the same amount of fat will retard more light when in small than when in large globules, these methods may give incorrect results and are therefore unreliable.

4.—*Formaldehyde, Test for.*—Deniges (*Jour. Phar. Chim.*) recommends the following method: To 10 c.cm. of milk add 1 c.cm. of fuchsine sulphurous acid. allow to stand five minutes; then add 2 c.cm. of pure hydrochloric acid and shake. If formaldehyde is not present, the mixture remains yellowish-white; while if present, a blue-violet color is produced. This test will detect 0.02 gram of anhydrous formaldehyde in one liter of milk.

5.—*Heated Milk, Test for.*—Wilkinson and Peters publish the following method of determining whether milk has or has not been heated: To 10 parts of the milk add 2 parts of a 4 per cent. alcoholic solution of benzidin, 2 parts of a 3 per cent. solution of hydrogen dioxide and a drop or two of acetic acid. A blue coloration is instantly produced in raw milk, but not in milk that has been heated above 137°F. In mixtures of raw and cooked milk, 15 per cent. of raw milk gives a distinct, and even 10 per cent. a faint blue coloration; but the addition of 5 per cent. of raw milk cannot be detected. If the hydrogen peroxide is omitted, the process may be used to detect the presence of that substance in the milk.

6.—*Litmus Test.*—H. D. Richmond (*Chem. News*) reports that litmus paper is entirely useless for testing the acidity of milk, this material often giving a reaction with perfectly fresh milk. Litmus paper may be either red, containing only the acid; or blue, containing besides the acid a varying amount of alkali, so that the paper may contain either all red particles of litmus, all blue, or an intermediate mixture of the two. If these varieties of paper are applied to partially neutralized acids of various strength contradictory results may be obtained. Milk contains phosphoric acid in several states of neutralization. If milk is tested with a blue litmus, the paper having its acid entirely neutralized is more alkaline than the milk, and a portion of the alkali will pass into the liquid until equilibrium is restored; in consequence the litmus becomes less alkaline and turns slightly red. If red litmus paper, which is more acid than the milk, is employed, alkali will pass from the liquid to the paper and turn it slightly blue. Litmus paper of some intermediate stage would not be affected.

7.—*Water, Test for.*—A German chemist furnishes a very simple procedure for testing the amount of water in milk. All that is required is a small quantity of plaster of Paris, say 1 oz. This is mixed with the milk to a stiff paste and then allowed to stand. With milk of 1,030 specific gravity and a temperature of 60°F., it will harden in ten hours; if 25 per cent. of water is present, in two hours; if 50 per cent., in one hour and a half; and with 75 per cent., in thirty minutes. Skimmed milk which has been standing for twenty-four hours, and is of 1,033 specific gravity, sets in four hours; with 50 per cent. of water in one hour, and with 75 per cent. in 30 minutes. Heat should not be applied, as then the use of the thermometer would be required. This test is certainly very simple and not costly.

POULTRY

Chicken Feed.

For Young Chickens.—Eggs which are not fertile are boiled for ½ hour and are then ground in a meat chopper without removing the shells. They are then mixed with six times their bulk of rolled oats. This mixture is used for 2 or 3 days, until the chicks have learned how to eat. It is fed in connection with chicken grit, short-cut clover or chaff. After the third day the chicks are fed a mixture of hard, fine broken grains. The following method (1) is recommended by the United States Department of Agriculture: Cracked wheat, 15 parts by weight; pinhead oats (granulated oatmeal), 10 parts; fine screened cracked corn, 15 parts; fine cracked peas, 3 parts; broken rice, 2 parts; chick grit, 5 parts; fine charcoal (chick size), 2 parts.

Several of the prepared dry commercial chicken feeds may be substituted for the broken grains if desired. They are not, however, to be considered more desirable than the home-mixed broken grains mentioned above. Where there is only a small quantity of chickens, it is perhaps as well to buy the feed ready prepared. The chicks should always have clean water, sharp grit and fine charcoal.

At 9 o'clock in the morning the rolled oats and egg mixture should be used, and they should not be allowed to feed more than five minutes. At 12.30 P. M. the hard grain mixture is fed and at 4.30 P. M. or 5 o'clock they are fed all they wish to eat of the rolled oats and egg mixture.

When they are about 3 weeks old the rolled oats and egg mixture is gradually displaced by a mixture having the following composition: Wheat bran (clean), 2 parts by weight; cornmeal, 4 parts; middlings, or "red dog" flour, 2 parts; linseed meal, 1 part; screened beef scrap, 2 parts.

This mixture is moistened with water just enough so that it is not sticky, but will crumble when a handful is squeezed and then released. The birds are developed far enough by this time so that the tin plates are discarded for light troughs with low sides. Young chicks like the moist mash better than that not moistened, and will eat more of it in a short time. There is no danger from the free use of the properly made mash twice a day, and since it is already ground the young birds can eat and digest more of it than when the feed is all coarse. This is a very important fact and should be taken advantage of at the time when the young chicks are most susceptible to rapid growth, but the development must be moderate during the first few weeks. The digestive organs must be kept in normal condition by the partial use of hard feed, and the gizzard must not be deprived of its legitimate work and allowed to become weak by disuse.

By the time the chicks are 5 or 6 weeks old the small broken grains are discontinued and the two litter feeds are wholly of screened cracked corn and whole wheat. Only good clean wheat that is not sour or musty should be used.

When young chicks are fed as described, the results have always been satisfactory if the chicks have not been given too much of the scratch feed and if the dishes of ground material have been removed immediately after the meal was completed. The objections to this system of feeding are the extra labor involved in preparing the eggs, mixing the feed with water and removing the troughs at the proper time.

Method 2 is similar to method 1, except that fine beef scrap is used instead of boiled eggs, and the mash is not moistened.

Early in the morning the chicks are given the hard feed on the floor litter as described in Method 1. At 9 o'clock they are fed a mixture having the following composition: Rolled oats, 2 parts by weight; wheat bran, 2 parts; cornmeal, 2 parts; linseed meal, ½ part; screened beef scrap, 1 part.

This is given in the plates or troughs, and the dishes are removed after ten minutes' use.

At 12.30 the hard grains are fed again, and at 4.30 or 5 the dry-meal mixture is given to them for half an hour or left until their bedtime. The meal being dry, the chicks cannot eat it as readily as they can the egg and rolled oats or the moistened mash. For that reason it is left for them to feed upon longer than when moistened with the egg and water, but is never left before them more than ten minutes at the 9 o'clock feeding time. The aim is to give them enough at each of the four meals so that their desire for food may be satisfied at the time, but to make sure that they have nothing left to lunch upon. It is desired to have their crops empty of feed before feeding them again. When treated in this way they will have sharp appetites when the feeder appears, and come racing out from the brooder to meet him. If they have been overfed at the previous meal, and have lunched when they saw fit, they do not care for the feeder's coming. If overfed a few times the creatures become debilitated and worthless.

What has been said so far is with reference to chicks that are hatched out in early spring, at a season of the year when it is impossible under the climatic conditions in Maine for them to get out of doors for work.

Feeding Hens.

The following method of feeding hens is that recommended in Farmers' Bulletin 357 of the Department of Agriculture, entitled "Methods of Poultry Management at the Maine Agricultural Experiment Station":

The method of feed now employed is in detail as follows: Early in the morning for each 100 hens 4 quarts of whole corn is scattered on the litter, which is 6 to 8 inches deep on the floor. This is not mixed into the litter, for the straw is dry and light, and enough of the grain is hidden so the birds commence scratching for it almost immediately. At 10 o'clock they are fed in the same way, 2 quarts of wheat and 2 quarts of oats. This is all of the regular feeding that is done.

The use of corn and corn-meal as major parts of the feed of hens kept for egg production has been very generally condemned by poultrymen and farmers, until it is now used only as a very minor part of the ration for the fear that its use will cause overfatness and interfere with egg making. When used more freely and made a prominent factor in the ration it has been thought best to have the kernels broken, so that in hunting and scratching for the small pieces the birds might get the exercise needed to keep themselves in health and vigor. It was reasoned that even a small quantity of whole corn could be readily seen and picked up from the straw litter with little exertion and that the vices of luxury and idleness would follow. In order to test this view an experiment was carried out at the station in the winter of 1906-7 in which whole corn was substituted for cracked corn in the ration of 500 laying pullets. A control lot of 500 received cracked corn. All other conditions affecting the two lots were kept as nearly identical as possible. The result of the experiment was that there was no appreciable difference in regard to either egg production, health or general well-being between the two flocks of birds.

Besides the dry whole grain a dry mash is kept always before the birds. Along one side of the room is the feed trough with its slatted front, and in it is kept a supply of dry meals mixed together. This dry-meal mixture or mash has the following composition: Wheat bran, 2 parts by weight; corn-meal, 1 part; middlings, 1 part; gluten meal or brewers' grains, 1 part; linseed meal, 1 part; beef scrap, 1 part.

These materials are spread on the floor in layers one above another and shoveled together until thoroughly mixed, then kept in stock for supplying the trough. The trough is never allowed to remain empty. The dry-meal mixture is constantly within reach of all of the birds, and they help themselves at will.

Oyster shells, dry cracked bone, grit and charcoal are kept in slatted troughs and are accessible at all times. A moderate supply of mangolds and plenty of clean water is furnished. About 5 pounds of clover hay cut into ½-inch lengths is fed dry daily to each 100 birds in winter. When the wheat, oats and cracked corn are given, the birds are always ready and anxious for them, and they scratch in the litter for the very last kernel before going to the trough where an abundance of feed is in store.

It is very evident that the hens like the broken and whole grains better than the mixture of the fine, dry materials; yet they by no means dislike the latter, for they help themselves to it, a mouthful or two at a time, whenever they seem to need it, and never go to bed with empty crops, so far as noted. They apparently do not like it well enough to gorge themselves with it, and sit down, loaf, get overfat and lay soft-shelled eggs, as is so commonly the case with Plymouth Rocks when they are given warm morning mashes in troughs.

Some of the advantages of this method of feeding are that the mash is put in the troughs at any convenient time, only guarding against an exhaustion of the supply, and the entire avoidance of the mobbing that always occurs at trough feeding when that is made a meal of the day, whether it be at morning or evening. There are no tailings to be gathered up or wasted, as is common when a full meal of mash is given at night. The labor is very much less, enabling a person to care for more birds than when the regular evening meal is given.

For green feed during winter and spring mangolds are used. They are liked by the birds, and when properly harvested and cared for remain crisp and sound until late spring. They are fed whole, by sticking them onto projecting nails about a foot and a half above the floor. Care must be exercised in feeding them, as they are a laxative when used too freely. On the average about a peck per day to 100 hens can be safely used. They would eat a much greater quantity if they could get it.

The average amounts of the materials eaten by each hen during one year are about as follows: Grain and the meal mixture, 90 lb.: oyster shell, 4 lb.; dry cracked bone, 2.4 lb.; grit, 2 lb.; charcoal, 2.4 lb.; clover, 10 lb.

Pigeons' Food.

Asafetida, 1 dram; potassium nitrate, 4 drams; magnesium sulphate, 1 oz.; prepared chalk, 1 oz.; licorice, 2 oz.; fine sand, 2 oz.; corn-meal, 12 oz.

Poultry Food.

Fecundity of the hen is dependent upon other things than the medicine which she takes. Birds in a wild state are independent of the apothecary; it is only when they have been deprived of their natural food and surroundings that chemicals have to be resorted to, and then with but doubtful effect.

Poultry to be profitable should be healthy, and to be healthy they should be kept clean, free from parasites, have plenty of room in which to rove by day, an airy roost by night, a variety of food, including green stuff and meat and gravel to aid in its digestion, and an abundance of fresh water.

Secluded retreats in which to make their nest should also be provided for the fowls.

But many fowls are deprived of some or all of these good things.

There is a great similarity between the various poultry powders and foods. The powders are popularly supposed to increase the egg-laying power of hens. We quote a few typical formulas:

1.—Powdered eggshell or phosphate of lime, 4 oz.; iron sulphate, 4 oz.; powdered capsicum, 4 oz.; powdered fenugreek, 2 oz.; powdered black pepper, 1 oz.; silver sand, 2 oz.; powdered lentils, 6 oz.

A tablespoonful to be mixed with sufficient food for twenty hens.

2.—Oyster shells, ground 5 oz.; magnesia, 1 oz.; calcium carbonate, 3 oz.; bone, ground, 1½ oz.; mustard bran, 1½ oz.; capsicum, 1 oz.; sodium chloride, 1 oz.; iron sulphate, ½ oz.; sodium carbonate, ½ oz.; sulphur, ½ oz.; beef, lean, dried and powdered, 10 oz.; fine sand, 10 oz.; corn-meal, 20 oz.; linseed-meal, 20 oz.

Reduce all to moderately coarse powder and mix well.

The above are formulas that are recommended by poultrymen, and pharmacists should not condemn them, even if they do seem polypharmic. Poultrymen have ideas of their own about the value of complicated formulae.

3.—Mustard, 4 oz.; fenugreek, 3 oz.; oyster shells, ground, 2½ oz.; bone, 1½ oz.; sodium sulphate, 1 oz.; capsicum, 2 oz.; black antimony, 2 oz.; venetian red, 2 oz.; corn-flour, 4 oz.; asafetida, 90 gr. Reduce all to powder and mix well.

A tablespoonful is to be mixed with sufficient meal or porridge to feed twenty hens.

4.—Iron sulphate, 1 oz.; red pepper pods, 1 oz.; black pepper, 2 oz.; calcium phosphate, 8 oz.; bread crust or crackers, 8 oz.; fenugreek, 4 oz. Powder the ingredients, and add four parts of clean white sand. If preferred, well boiled white beans may be used instead of the bread crust. The beans should be pressed through a colander to remove the hull, and then worked up with the powders. Label as follows: "For every dozen hens, add one level tablespoonful of the powder to the ordinary food, mixing it thoroughly, so that it may be as evenly distributed as possible.

5.—Bone, ground, or slacked lime, 12 oz.; gentian, powdered, 1 oz.; capsicum, powdered, 1 oz.; ginger, powdered, 2 oz.; sulphur, 1 oz. Put a teaspoonful in a quart of food.

6.—Ground bone or phosphate of lime, 12 oz.; capsicum, 1 oz.; ginger, 2 oz.;

cantharides, 1 dram; potassium nitrate, 1 oz. Put a teaspoonful in a quart of food.

7.—Oyster shells in coarse powder, 2,400 parts; calcium carbonate, 380 parts; calcium phosphate, 380 parts; powdered black pepper, 500 parts; powdered red pepper, 40 parts; iron oxide, 60 parts; chlorides, phosphates and sulphates, soluble in water, 80 parts.

8.—Powdered red pepper, 2 oz.; powdered allspice, 4 oz.; powdered ginger, 6 oz. Mix by sifting. One tablespoonful to be mixed with every pound of food and fed two or three times a week.

9.—Mix the following substances thoroughly after they are reduced to a coarse powder: 1 part of sodium chloride, ½ part of iron sulphate, the same quantity of sodium carbonate and the same quantity of sulphur. Add 10 parts of lean beef, dried and pulverized, 10 parts of fine sand, 20 parts of Indian corn, and as much linseed cake.

Remedies for Croup, Gape, Lice, Etc.

1.—*Croup.*—Potassium chlorate, 2 av.oz.; cubebs, 2 av.oz.; anise, 1 av.oz.; licorice root, 3 av.oz. Reduce all to powder and mix well. Mix a teaspoonful of this with food for sixty hens.

2.—*Gape Cure.*—Take a wooden box, a little bigger than a biscuit-tin, and divide it in two by means of a piece of wire netting. Place half of an ordinary brick, made very hot by means of fire, on one side of wire netting and the chicks on the other. Cover the whole box with a cloth, and then insert under the cloth a tablespoon with teaspoonful of carbolic acid. Pour the liquid on to the hot brick and withdraw spoon. The fumes will cure the chicks in two minutes.

Take out the chicks just before they are apparently suffocated.

Be careful to keep the hands and face away from the liquid when it is poured on to the brick, as it will blister the skin.

If chicks are not cured keep them in the fumes longer.

b.—Powdered camphor, 4 drams; peroxide of iron, 8 drams; powdered fenugreek, 8 drams; powdered licorice, 3½ oz. Mix. Two teaspoonfuls to be mixed with the food of a dozen fowls.

3.—*Lice Exterminator.*—a.—Make the roosts perfectly clean with hot soap and water, and afterward apply spirits of turpentine or kerosene oil. Also strew some sprigs and branches over the floor of the coop. The building should be kept clean.

b.—Gas tar, 12 oz.; sodium hydroxide, 2 oz.; sulphur, 4 oz.; rosin, 2 oz.; water, 1 gal. Boil the tar with the soda and some of the water; add the rosin; after dissolving, add the sulphur and the balance of the water.

4.—*Roup.*—a.—Licorice,—2 oz.; anise, 1 oz.; cubebs, 1 oz.; capsicum, 10 gr.; potass. chlorate, 1 oz. The ingredients, all in fine powder, should be intimately mixed.

b.—Calomel, 1 dram; antimonial powder, 1 dram; powdered licorice, 1 dram; copaiba, enough. Make sixty pills, and give one night and morning.

5.—*Tonic Pills for Pigeons and Poultry.*—The following two formulas are from the *Pharmaceutical Journal:* a.—Red cinchona bark, 1 gr.; extract of calumba, 60 gr.; extract of chamomile, 60 gr.; extract of gentian, 60 gr. Mix. Dose, 4 to 12 grains.

b.—Ferrous sulphate, 60 gr.; extract of jaborandi, 1 gr. Mix. Dose 2 to 6 grains.

c.—Gentian, 1 dram; capsicum, 1 dram; fenugreek, 1 dram; black antimony, 2 drams; licorice, 6 oz. Reduce all the ingredients to powder and mix thoroughly. Put a tablespoonful in the food for two or three dozen times, every day or two.

Weight of Hen Eggs.

A German agricultural journal gives the following table showing the variation in weight between eggs of the same family of chickens, and of the comparative value of the product of different kinds of fowls:

	Weight of Whole Eggs. Grains.	Shell. Grains.	Net.
Common hen, small	635,60	84.86	550.54
Common hen, mean	738.35	92.58	645.77
Common hen, large	802.36	93.25	709.11
Italian hen........	840.00	92.50	747.50
Houdan	956,60	93.50	853.10
La Flesche.........	926.50	94.25	835.25
Brahma	1,025.50	114.86	910.64

From this it will be seen that the Houdans and Brahmas are the most profitable producers, as far as food value is concerned—provided, of course, they are equally prolific with the ordinary fowl.

Another calculation made by our authority is the number of eggs to the pound, of the various weights. This is as follows: Small ordinary eggs (635 gr.), 12.20; large ordinary eggs (802 gr.), 9.25; Houdan eggs, 8; Brahma, mean, 7.4; Brahma, large 7.1.

VETERINARY FORMULAS

Miscellaneous.

Anesthetics.—The following are taken from the *Revue pharm. des Flandres*:

1.—Billroth's Mixture.—Chloroform, 3 parts; sulphuric ether, 1 part; alcohol, 1 part.

2.—English Mixture.—Sulphuric ether, 3 parts; chloroform, 2 parts; alcohol, 1 part. Mix.

3.—Wachsmith's Mixture.—Chloroform, 5 parts; oil of turpentine, rectified, 1 part.

Condition Powder for Stock.—1.—Cream of tartar, 5 lb.; sulphur, 5 lb.; white rosin, 5 lb.; gum guaiacum, 3 lb.; potassium nitrate, 2 lb.; gentian, 5 lb.; sulphuret of antimony, 6 oz. Reduce the ingredients to fine powder and mix intimately.

2.—Sulphur, 2 lb.; fenugreek, 4 lb.; cream tartar, 1 lb.; licorice, 1 lb.; black antimony, ½ lb.; gentian, ¼ lb.; aniseed, ¼ lb.; common salt, 1 lb. Dose, 1 oz. daily for 2 or 3 weeks.

3.—Powdered fenugreek, 3 oz.; powdered black antimony, 2 oz.; sulphur, 4 oz.; powdered rosin, 2 oz.; powdered nitrate of potassium, 3 oz.; Epsom salt, 6 oz.

4.—Saltpeter, 1 oz.; ginger, 2 oz.; fenugreek, 3 oz.; black antimony, 1 oz.; licorice, 1 oz.; linseed meal, 8 oz.

Embrocations.—1.—White of 3 eggs; pyroligneous acid, 5 oz.; water, 5 oz.; oil of turpentine, ¼ oz.; alcohol, 6 oz.

2.—Spirit of camphor, 1 pt.; tincture of capsicum and myrrh, 12 oz.; oil of turpentine, 12 oz.; linseed oil, 4 oz.; oil of stone (crude petroleum), 1½ pt.; oil of amber, 2 oz.; oil of origanum, 3 oz.; Barbadoes tar, 1½ oz.

3.—Barbed Wire Liniment.—a.—Crude carbolic acid, 4 oz.; pine tar, 4 oz.; oil of spike, 4 oz.; cheap lubricating oil, to make 4 pt. The lubricating oil here mentioned may be any that happens to be on hand, but the best is the heavy, stiff, cheap "black oil" which may be purchased at about 10 cents a gallon. This oil is a good healing agent of itself, and is also a good disinfectant and insecticide. It is largely used for this latter purpose, and with very satisfactory results.

b.—Carbolic acid, ¾ oz.; spirits turpentine, 1¼ oz.; pine tar, 2½ oz.; fish oil, q. s. 16 oz. M.:—Apply to cuts after first washing with warm water and castile soap.

3.—Carbolic acid, 4 fl.dr.; pine tar, 2 oz.; oil turpentine, 1 fl.oz.; fish oil, to make 1 pt.

d.—Raw linseed oil, 10 oz.; pot. nitrate, 1 oz.; lead acetate, 1 oz.; sulphuric acid, 1 oz.; carbolic acid, ½ oz. Mix carefully.

4.—Magoffin's Queen Balm.—Camphor, 2 oz.; myrrh, 2 oz.; guaiac, 1 oz.; capsicum, 2 oz.; oil of sassafras, 1 oz.; oil of hemlock, 1 oz.; alcohol, 1 gal. Macerate, with occasional agitation, for seven days; then filter.

For bruises, sprains, frostbites, burns, rheumatism, ulcers, etc., use by applying freely to all parts affected, "warming it in" well with warm flannel.

Magoffin's Horse and Cattle Powder.—Powdered copperas, 5 lb.; powdered rosin, 5 lb.; powdered sulphur, 5 lb.; powdered saltpeter, 3 lb.; ground oil cake, 10 lb.; powdered asafetida, 3 lb.; powdered alum, 3 lb. Mix carefully by means of sieve. Directions: Give a horse a heaping spoonful every morning, in wet oats or provender, for six or eight mornings; afterward the same every other day for a few days. The same dose for a hog or cow and double the quantity for an ox.

Cattle.

1.—*Calf Meal.*—Pea meal, 3½ lb.; lentil meal, 3½ lb.; fenugreek, ½ lb.; barley meal, 14 lb.; crushed linseed, 7 lb. Mix.—*Chem. and Drug.*

2.—*Nutritive Powder for Cattle.*—a.—Fenum grecum, 4; linseed, 4; juniper berries, 4; rosin, 4; mustard, 4; Glauber's salt, 3; common salt, 3; flowers of sulphur, 3; green vitriol, 3; black antimony, 1; Chili saltpeter, 1; coriander, 1.

b.—Sulphide of antimony, 4; flowers of sulphur, 4; bean or malt flour, 225. Dose, 1 tablespoonful in the feed.

c.—Flowers of sulphur, 2; fenugreek seed, 4; tartar, 1; licorice, 1; Chili saltpeter, 1; sulphide of antimony, 0.5; gentian, 0.25; aniseed, 0.25; common salt, 1. Dose, 1 oz. daily for two or three weeks.

d.—Gentian, 4; licorice, 4; fenugreek, 16; saltpeter, 4; common salt, 4.

e.—Aromatic powder, 2; asafetida, 0.25; tartar, 0.75; sulphide of antimony, 0.5.

f.—Sulphide of antimony, 10; flowers of sulphur, 9; elm bark, 4; rosin, 2; Chili saltpeter, 2; aniseed, 1. Dose, heaped tablespoonful once or twice a day.

g.—Anhydrous green vitriol, 5; cantharides, 1; ginger, 3; sulphide of antimony, 6; Chili saltpeter, 5; flowers of sulphur, 10; linseed, 10; gentian, 7; tartar, 3; rosin, 5; aniseed, 5. Dose, one tablespoonful once or twice a day in the feed, or mixed with molasses, honey, or glycerine in one mass, which is given in a capsule of gum.

h.—Tartar, 5; flowers of sulphur, 5; rosin, 5; guaiacum, 3; Chili saltpeter, 2; gentian, 5; golden sulphur, 6.

i.—Gentian, 100; fenugreek, 50; fennel, 50; cattle salt, 300; bicarbonate of soda, 100; Glauber's salt, 400; saltpeter, 50; juniper berries, 400.

3.—*Milk Powder for Cows.*—a.—For increasing the flow of milk in cows, Hager's Manual recommends the following mixture: Potassium nitrate, 1 part; alum, 1 part; sublimed sulphur, 1 part; prepared chalk, 1 part; white bole, 2 parts; red clover, 5 parts; anise, 10 parts; fennel, 10 parts; salt, 10 parts. All should be in tolerably fine powder and should be well mixed. The directions are to give one or two handfuls with the morning feed.

b.—Dieterich's Manual recommends this: Caraway, 12 parts; calamus, 12 parts; salt, 5 parts; sulphur, 3 parts. Give twice daily two heaping tablespoonfuls of this powder in a liter of warm beer.

4.—*Spiced Cattle Food.*—Locust bean meal, 6 cwt.; Indian meal, 10 cwt.; linseed cake meal, 3 cwt.; sulphur, 1 qr. 12 lb.; saltpeter, 1 qr. 12 lb.; common salt, 1 qr. 2 lb.; fenugreek, 20 lb.; gentian, 10 lb.; sulphate of iron, 5 lb.; aniseed, 4 lb.; ground ginger, 3 lb.; total, 20 cwt. 1 qr. 12 lb.

Dogs.

Appetite Pills for Dogs.—Calamus, 6 grams; dried sodium sulphate, 6 grams; sodium bicarbonate, 2 grams; powdered rhubarb, 2 grams. Mix and form into six pills, with syrup. Give one pill twice daily.

Asthma.—1.—Asthma claims its victims among dogs, especially old or pet dogs overfed with sweets and meat. The most striking symptom is difficulty in breathing. The respiratory movement is done by two apparent efforts, but the inspiration is performed with ease. Respiration is more difficult after feeding, being accomplished by a peculiar cough resembling a grunt. The animal does not thrive, and becomes pot-bellied. A good sharp purgative should be given, and the bowels kept open for some time. All luxuries must be withdrawn, only good food, such as porridge, being given. If the patient cannot relish such simple food let it do without. A teaspoonful of the following mixture should be given twice daily or when breathing becomes painful and heavy: Liq. arsenicalis, 1 dram; spt. ether nit., 2 drams; spt. ammon. arom., 2 drams; syr. scillae ad., 1 oz.

2.—For Chronic Asthmatic Cough: Extract of hemlock, 30 gr.; extract of henbane, 10 gr. powdered digitalis, 20 gr. Form a mass with conserve of rose or other suitable excipient, and make into ten pills. Give one night and morning.

Catarrh.—Catarrh (coryza or cold) affecting the head is a common and troublesome complaint to which the dog is subject. There is no doubt that it is a form of influenza, and it often accompanies distemper. The complaint is not usually dangerous, nor does it prove fatal in the majority of cases, but may develop seriously if neglected. The affected animal is more or less feverish, with or without a discharge from the eyes and nostrils. There is also a certain amount of sneezing, and occasionally a sore throat is contracted. In treating such cases, give a mild dose of castor oil or glycerine. Keep the dog in a warm and even temperature and hold its head over a basin of hot water containing a teaspoonful of eucalyptus oil to each pint of water. The following mixture should be given in doses of one teaspoonful night and morning: Tr. opii, 1 dram; tr. lavand. co., 1 dram; tr. camph. co., 4 drams; liq. ammon. acet., 2 drams; syr. scillae ad., 2 oz. If the throat seems to be much inflamed or painful a poultice of hot sand or salt tied around the neck close up to the head will gradually give relief.

Colic.—Colic is an ailment to which dogs are subject, although the fact is not generally known, as the animal has all the appearance of being mad—the ignorant immediately pronouncing it as such. Treatment should begin with a good dose of a purgative, followed by whisky, laudanum, chlorodyne or other anodyne at hand. Rub the stomach well and apply hot cloths at intervals, or preferably give a good warm bath, rubbing well while in the bath and dry thoroughly afterward. Keep the dog warm and dry until purgation ensues. In after-feeding give small pieces of fish, beef tea, soups, etc., to assist the stomach to recover normal action.

Constipation.—Magnesium sulphate, 1 oz.; syrup of buckthorn, 4 drams; compound tincture of chloroform, 30 minims;

water, enough to make 6 oz. Dose, from 2 drams to 2 oz. in the morning. Let the animal have all the dog grass (triticum) he will eat. In a field he will find it for himself, or if it is gathered and taken to him fresh, he will eat it.

Cough Mixture.—Tincture of belladonna, 4 drams; syrup of squill, 4 drams; paregoric, 1 oz.; water, enough to make 6 oz. Dose, a teaspoonful three times a day.

Diarrhea.—Rub the abdomen with a mixture of equal parts of the spirits of camphor and juniper, and give each morning and evening a pill containing: Opium, 3 gr.; althea, 3 gr.; licorice root, 15 gr. Keep the animal warm and feed him on simple, easily digested foods.

Distemper.—1.—Distemper is one of the most common diseases among young dogs, and has been likened to measles. For its cure, a pill, two or three times a week, composed of the following, has been recommended: Antimonial powder, 2½ gr.; mercury with chalk, 2 gr.; Dover's powder, 3 gr.; quinine sulphate, 1½ gr.; extract of nux vomica, ⅛ gr. It is well to see that the animal's bowels are kept open.

2.—Fluid extract of buckthorn, 1 oz.; tincture of ginger, ½ oz.; syrup of poppies, 2 oz.; syrup, 1 oz.; cod-liver oil, enough to make 8 oz. Give a dessertspoonful three times a day.

Dog Biscuit.—The *Pharmaceutische Zeitung* of Berlin gives the following description of the manufacture of dog biscuit:

The waste portions of meat and tallow, including the skin and fiber, have for years been imported from tallow factories in the Argentine Republic, in the form of great blocks, and most of the dog bread made by modern manufacturers consists principally of these remnants, chopped and mixed with flour. They contain a good deal of firm fibrous tissue and a large percentage of fat, but are lacking in nutritive salts, which must be added to make good dog bread, just as in the case of the meat-flour made from the waste of meat-extract factories. The flesh of dead animals is not used by any reputable manufacturers, for the reason that it gives a dark color to the dough, has an unpleasant odor, and, if not properly sterilized, would be injurious to dogs as a steady diet.

Wheat flour, containing as little bran as possible, is generally used, oats, rye or Indian corn being only mixed in to make special varieties, or, as in the case of Indian meal, for cheapness. Rye flour would give a good flavor, but it dries slowly, and the biscuits would have to go through a special process of drying, after baking, else they would mold and spoil. To make it keep well dog bread must be made from good wheat flour, of a medium sort, mixed with 15 or 16 per cent. of sweet, dry chopped meat, well baked and dried like pilot bread or crackers. This is the rule for all the standard dog bread on the market. There are admixtures which affect more or less its nutritive value, such as salt, vegetables, chopped bones or bone-meal, phosphate of lime and other nutritive salts. In preparing the dough and in baking, care must be taken to keep it light and porous.

Ear Canker.—1.—Do not use a strong styptic, as is frequently done, but an emollient—say, at first, a little warm oil of sweet almond. This the dog will not resent, and afterward he is willing to be treated further, while if the first application hurts him there will be trouble about giving a second. The following is a good lotion: Zinc oxide, 1 dram; zinc sulphate, 10 gr.; boric acid, 30 gr.; glycerine, 4 drams; water, enough to make 3 oz.

2.—A dry dressing of iodoform, boric acid, zinc oxide, or starch will sometimes effect a cure.

3.—For old ulcerations use: Carbolic acid, 10 m.; oil of sweet almond, 1 oz. Administer mild laxatives and do not allow the ear to get wet.

Emetic Powders.—Calomel, 45 gr.; tartar emetic, 45 gr.; vermilion, 1 gr. To produce emesis give from 1 to 3 gr.; dropped on the tongue or with milk. A like quantity of tartar emetic alone; or of turpeth mineral, have the same effect; or a teaspoonful of common salt may be given.

Fits, or Epilepsy.—Zinc oxide, 20 gr.; sulphur, 75 gr.; jalap, 75 gr.; extract of green hellebore, 20 gr.; extract of gentian, enough to form a mass. Make 60 pills and give one three times a day.

Gastritis.—Over-feeding or the presence of a fish bone in the membrane of the stomach are two things, among others, which may cause gastritis in a dog. Frequent vomiting of water, inability to retain food, great thirst, and rapid loss of condition mark this trouble. Sometimes the patient will stretch his abdomen out over a cool stone, as if to allay internal burning. Give him bismuth subcarbonate, 6 gr.; diluted hydrochloric acid, 2 m.; compound tragacanth powder, 2 gr.; water, enough to make 90 m. Give also plenty of ice-cold water and a few drops of brandy now and then. Keep the patient on milk diet, milk puddings, etc.

Laxative Draft.—Magnesium sulphate, 2½ drams; potassium nitrate, 30 gr.; tincture of jalap, 25 m.; water, enough to make 1 oz.

Mange.—This is a parasitic disease, there being two kinds, one caused by the sarcoptes canis and the other, and more slow and persistent kind, by the demodex folliculorum.

1.—For the first kind a wash made of equal parts of the oils of tar, olives and turpentine is good, or an ointment consisting of: Sulphur, 1 oz.; potassium carbonate, 30 gr.; petrolatum, 4 oz.

2.—The other kind of mange, which causes the dog to rub his back under chair rounds, etc., is treated by closely clipping the hair over the affected portions—along the spine—and rubbing every day with: Creosote, 4 drams; olive oil, 7 oz., solution of potassa, 1 oz.

3.—Yellow mercurous iodide, 10 gr.; salicylic acid, ½ oz.; sublimed sulphur, 3 oz.; pine tar, 3 oz.; coal tar, washed, 3 oz.; sturgeon oil, enough to make 2 pt. Shake well and apply at night; wash off in the morning.

4.—Soft soap, 4 parts; B-naphthol, 1 part; storax, 2 parts; tobacco extract, 3 parts. To be applied to one-third of the skin at the most for three consecutive days. After three applications, wash the whole body with water in which ordinary carbolic acid soap has been dissolved.

5.—The following from Dieterich's Manual may answer your purpose: Potassium sulphide, 50 parts; tar, 50 parts; glycerine, 50 parts; soft soap, 350 parts. Heat gently and mix well. Two tablespoonfuls of this is mixed with a pint of warm water and the animal washed with the solution, which is allowed to dry on the skin. Two days after a washing with soap and water is given and the solution applied as before; the treatment being continued in this way as long as necessary.

Rheumatism.—Wine of colchicum, 3 m.; sodium salicylate, 5 gr.; water, enough to make I dram. Two such doses to be given daily. The affected parts should also be rubbed with a good liniment every day, and the dog kept on a milk diet.

Skin, To Make Fine.—Give a teaspoonful of tar, says Mayer, made up with oatmeal.

Tonic Pills.—1.—Gentian, 15 gr.; ginger, 5 gr.; cascarilla, 15 gr. Make a pill, and give one such every day.

2.—Pil. blaud, 5 gr.; acid, arsenios, 1-16 gr. Ft. pill. Rose, one every morning after food for small dogs. For larger dogs, one night and morning. These pills can be given in all skin diseases of dogs, with marked benefit; they are also very useful as a tonic for dogs whose age begins to tell on them.

3.—Blue mass, 1 dram; aloes, 2 drams; myrrh, 1½ drams; benzoin, 1½ drams; balsam of peru, 1½ drams. Make 15 pills and give one night and morning.

Vomitting, To Prevent.—Bismuth subnitrate, 8 oz.; opium, 1½ gr.; gum arabic, 8 gr.; sugar, 15 gr. Make a powder and give at once. It is not always best to try to prevent vomiting, as nature frequently comes to the relief.

Worms.—1.—Areca nuts given to a dog are a sovereign remedy for tapeworms. The nuts should be freshly ground and the dose in 2 grains to each pound of dog, given at night and followed next morning by a brisk purgative, as castor oil.

2.—As there are different kinds of worms a mixture which contains a dose of each kind is not bad, the following formula being for something of this class; Santonin, 2 gr.; powdered glass, 5 gr.; powdered areca nuts, 10 gr. Oil of male fern sufficient to make a pill.

3.—Powdered areca nuts, 5 gr.; santonin, 1 gr.; molasses, q. s. to mass. Fiat pil. Dose, one or two pills, according to the size of the dog.

Wounds and Sore Feet, Astringent Lotion for.—Bruised oak bark, 2 oz.; catechu, 1 oz.; water, 3 pt. Boil to 1 point, and strain.

Hog Cholera.

No form of treatment has yet been found, so far as we are able to learn, which is in every way satisfactory. The disease is a contagious one and preventive measures and the enforcement of proper sanitary regulations count quite as much, if not more, than medicine. The veterinarian of the Indiana Experiment Station, in discussing the subject, makes the following observations:

"The hogs should not have access to ponds or wallows, as this affords favorable conditions for the germs. The drinking water should be from deep wells. the food should be clean and often changed. If a hog has been separated from the herd and recovers it should not be returned to the herd for several weeks, as it is capable of giving the disease to others, although it may appear to be perfectly well. Hogs should not be kept in pens where the disease has been for three months. All dead animals should be burned or buried deeply in places where hogs will not graze for a year. Diseased hogs should not be driven through lanes or other public highways. The healthy hogs should be cared for first and then the diseased, otherwise disease-bearing material may be conveyed to the healthy. Clean the pens, use plenty of air-slacked lime on the floors before using again."

The following formula given by the Bureau of Animal Industry is as efficacious as anything known as a preventive and remedy:

1.—Wood charcoal, 1 lb.; sulphur, 1 lb.; sodium chloride, 2 lb.; sodium hyposulphite, 2 lb.; sodium bicarbonate, 2 lb.; sodium sulphate, 1 lb.; antimony sulphide, 1 lb. Give a tablespoonful once a day to a 150-pound hog. Give in sloppy feeds, as bran, middlings, crushed oats, etc.

Several other formulas are as follows:

2.—Iron carbonate, 5 parts; sodium chloride, 5 parts; potassium carbonate, 5 parts; sulphur, 5 parts; calcium oxide, 5 parts; magnesium carbonate, 10 parts; soap, 10 parts; chalk, 60 parts; carbolic acid, 5 parts. Dose: Give ¼ of an ounce of the mixture at each feed, well mixed with food.

The two following formulas are ascribed to Dr. Haubner, Dean of the Dresden Veterinary College:

3.—Calcium phosphate, precipitated, 16 parts; chalk, 12 parts; magnesium carbonate, 4 parts; capsicum, 1 part.

4.—Sodium bicarbonate, 2 parts; gentian root, 2 parts; ginger, 3 parts; sodium nitrate, 1 part; chalk, 8 parts. As a prophylactic, give 1 to 2 teaspoonfuls twice a day; as a cure, give 1 tablespoonful three or four times a day.

5.—Potassium nitrate, 4 oz.; black antimony, 4 oz.; gentian, in powder, 4 oz.; rosin, 8 oz.; turmeric, 8 oz.; madder, 8 oz.; sublimed sulphur, 8 oz.

Horses.

Blind Staggers (White).—Epsom salt, 8 oz.; water, 24 oz. Dissolve. Give as a drench.

Bots (Houck).—Rosin, 2 oz.; saltpeter, 1 oz.; gentian, 2 oz.; copperas, 2 oz.; fenugreek, 4 oz. Mix. Tablespoonful at night.

Colic.—Horses are liable to rapid inflammation of the bowels, which is very often mistaken by the horse-keeper for colic and treated for such, when the services of a veterinary doctor are vitally important. Colic primarily comes from indigestion or constipation or both. The first thing to do is to relieve the pain, the next to cause an evacuation of the bowels. For the pain, give the following as a drink in a quart of hot water:

1.—Tincture of opium, 1 oz.; tincture of ginger, 1 oz.; sweet spirit of niter, 1 oz.; chloroform, 1 oz. This is a full dose for a large horse. For a small horse or a slight attack less may be given.

The best purgative to use in colic is a pint of castor oil or a quart of linseed oil. A dram of oil of turpentine should be given also.

2.—Another.—Tincture of opium, 1 oz.; ol. terebinth, ½ oz.; spirit ether nit., 2 oz.; ol. lini., 8 oz. Mix. Shake well before giving, and if relief is not procured in 30 minutes and the horse is shivering and has cold sweats, call a veterinary at once.

In case of simple colic this drink will give quick relief; it should be followed by a warm bran mash one hour after.

Condition Powder.—Gentian root, aniseed, caraway seeds, linseed, coriander seeds, rosin, saltpeter, licorice root, fenugreek of each 1 lb. To the above ingredients, all in fine powder, add oil of cloves 2 drams and mix well in a large mortar; it is not necessary to sieve, if the rosin and saltpeter are finely powdered before mixing.

One or two tablespoonfuls mixed well with the food every night and morning for a week or two, then once a day.

For carriage horses, a warm bran, barley or oatmeal mash occasionally, works wonders in conjunction with the condition powders.

Distemper (Millican). — Arsenic, 1 dram; sodium bicarbonate, 1 oz.; iron iodide, 4 drams; fenugreek, 2 oz.; ginger, 2 oz.; elecampane, 1 oz. Make into 12 powders. One at night.

Epizooty—Pinkeye (Bell). — Sublimed sulphur, 4 drams; Epsom salt, 1 oz.; charcoal, 4 drams; licorice extract, 1 oz.; elecampane, 1 oz.; fenugreek, 1½ oz.; gentian, 4 drams; aniseed, 2 drams; ginger, 2 drams; saltpeter, 4 drams; rosin, 2 drams; copperas, 2 drams; black sulphide antimony, 6 drams. Mix. Tablespoonful three times daily.

Farcy (Dodd).—Saltpeter, 2 oz.; elecampane, 1 oz.; sodium sulphite, 4 drams; black sulphite antimony, 1 oz. Mix. Tablespoonful twice a day.

Feed, Comparative Value of. — The comparative value of horse feed is found by experiment to be as follows: 100 lb. of good hay is equal in value to 59 lb. of oats, 57 lb. of corn, 275 lb. of carrots, 54 lb. of rye or barley and 105 lb. of wheat bran.

Founder.—1.—(White).—Capsicum, 30 gr.; tincture aconite root, 15 drops; cider vinegar, 6 oz.; water, 1 pt. Mix. Give as a drench and blanket the animal. After two hours give one pint of raw linseed oil.

2.—(Biddle).—Tincture aconite root, 10 drops; tartar emetic, 15 gr.; saltpeter, 1 dram; ginger, 2 drams; linseed meal, 1 oz. Make into bolus. Give at once and repeat every six hours if required.

3.—(Biddle).—Soap liniment, 3 oz.; aqua ammonia, 1 oz.; spirits camphor, 1 oz.; oil turpentine, 4 drams; oil peppermint, 2 drams; tincture capsicum, 2 drams; tincture opium, 4 drams; petroleum, 2 oz. Mix. Rub the legs well three times during the day and at night.

Gall Cures.—Galls on horses produced by badly fitting saddles or harness are hard to cure. The sores should be washed two or three times a day with water and a healing ointment or wash applied by means of a soft cloth or a dusting powder. Some formulas follow:

1.—Zinc oxide, 1 oz.; water, 1 oz.; mutton tallow, 2½ oz.; lard, 5 oz.

2.—Tannic acid, 1 oz.; powdered camphor, 2 oz.; zinc oxide, 3 oz. Mix and sift through a fine sieve and dust on the raw places.

3.—Compound tincture of benzoin is a good remedy for sores or cuts on animals.

4.—(Karie).—Red lead, 2 oz.; lead acetate, 1 oz.; beef suet, 12 drams; linseed oil, 8 oz. Heat and stir constantly until it assumes a brown color. Apply once daily.

5.—(Martin).—Carbolic acid, 10 m.; tincture aloes, 1 oz.; tincture myrrh, 4 drams; tincture opium, 4 drams; witch hazel water, 4 drams. Mix. Bathe the part often.

6.—Zinc oxide, 1 oz.; burnt alum, 1 oz.; camphor, 1 oz.; phenol, ½ oz.; calomel, ½ oz.; bismuth subgallate, ¼ oz.; benzoniated lard, 4 oz.; petrolatum, 12 oz. Mix the powders well together and reduce them to a smooth paste with the camphor, previously dissolved in the phenol. If desirable to make the paste perfectly smooth, a little castor oil may be used. Now add the lard and petrolatum and mix well. In warm weather 2 ounces of the petrolatum should be replaced by wax.

Grease in Horses.—Citrine ointment, 2 oz.; lard, 1 oz.; oil of turpentine, ½ oz.; saturated solution of copper nitrate, 2 drams. The word "grease" here is the name of the disease, not of the remedy.

Hide-Bound. — a.—(Bell). —Fenugreek, 4 oz.; sublimed sulphur, 2 oz.; cream tartar, 1 oz.; licorice, 1 oz.; saltpeter, 1 oz.; sodium chloride, 1 oz.; black antimony sulphide, 4 drams; gentian, 2 drams; aniseed, 2 drams. Mix. Tablespoonful night and morning.

b.—*Hide-Bound* (Pinkard). — Elecampane, 2 oz.; licorice root, 2 oz.; fenugreek, 2 oz.; rosin, 2 oz.; copperas, 4 drams; ginger, 2 drams; gentian, 1 dram; saltpeter, 1 dram; valerian, 1 dram; linseed meal, 3 oz.; sublimed sulphur, 1 oz.; black antimony sulphide, 4 drams. Mix. Tablespoonful in feed, twice a day.

Hoofs.—Grease for: Horse grease, 5,000 parts; tallow, ordinary quality, 2,000 parts; train oil, 3,000 to 5,000 parts; oleic acid, 1,000 to 1,200 parts; lampblack, sufficient for coloring; nitrobenzol, 100 parts.

Cement.—a.—Gum ammoniac, purified, 0.3 kilogram; thick turpentine, 0.1 kilogram. Melt in the water bath and gradually add with constant stirring 0.6 kilogram of gutta percha. If black hoof cement is desired, rub up 20 grams of lampblack with a little turpentine before the melting. For use, soak the mass in hot water and press it into the clefts of the hoof, which have previously been carefully cleaned.

b.—Two parts of gutta percha are softened with pure water and divided into pieces as large as a nut, then melted over a slow fire in a tinned iron pan, constantly stirring, with 1 part of crushed gum ammoniac, until the mass has acquired the color and appearance of chocolate. Before using, the mass must be melted again and is then applied with a warm knife blade to the cracks and splits in a horse's hoof, just as a glazier works with his putty, the hoof having previously been carefully cleansed. The mass hardens so that it will allow of nails being driven into it.

Influenza (Caulk).—Ammonia muriate, 12 drams; gum camphor, 4 drams; potash chlorate, 1 oz.; powdered extract licorice, 2 oz.; molasses, sufficient. Make into a mass. Dose: A tablespoonful, in form of bolus, night and morning.

Knee Ointment.—Mercurial ointment, 2 oz.; honey, 1 oz.; camphor, 2 drams; burned cork, powdered, 2 drams.

Lameness.—The following will not cure, nor is it suitable if the lameness is severe and of long standing: Oil origanum, ½ oz.; soap liniment, 1 oz.; tincture of opium, 1 oz.; spirits turpentine, 1½ oz.; spirits hartshorn, 2 oz.; spirits camphor, 2½ oz. Mix.

Liniments.—1.—Camphor, ½ oz.; tincture of iodine, ½ oz.; tincture of capsicum, 1 oz.; aromatic spirits of ammonia, 1 oz.; tincture of opium, 1 oz.; oil of turpentine, 4 oz.; alcohol, enough to make 2 pints. Mix, putting in the oil of turpentine last of all.

Rub well into the affected parts, once or twice a day. This liniment is excellent for sprains, stiffness, sore muscles from hard work and sweeny, big shoulder, fistula, etc., and, in fact, anywhere that a strong, penetrating liniment is useful. It is not suited for wire cuts and other wounds, however.

2.—Oil of turpentine, 1 fl.dr.; oil of thyme, 1 fl.dr.; crude oil of amber, 1 fl.dr.; black oil, 2 fl.dr.; kerosene oil, 6 fl.dr.; water, 6½ fl.oz.; soap, 70 gr.; caustic potash, 6 gr. Place the soap and the potash in a flask and dissolve in two ounces of hot water; mix the oils and add to the solution gradually, with vigorous shaking, and lastly add the water, continuing the agitation to make an emulsion.

3.—Rape seed oil, 2 fl.oz.; soft soap, 3 oz.; oil of turpentine, 10 fl.oz.; stronger water of ammonia, 2½ fl.oz.; acetic acid, 2 fl.oz.; camphor, 3 oz.; alcohol, 4 fl.oz.; rectified oil of amber, 2 fl.oz.; water sufficient to make 40 fl.oz.

Rub the soap gradually with 5 ounces of water to form a smooth jelly; add the alcohol with the camphor dissolved in it; mix the turpentine and oil of amber, and add gradually to the mixture with constant stirring, aiding the emulsification by the occasional addition of a little water. Then add the ammonia and transfer to ar emulsion machine or large bottle, subsequently adding gradually the acetic acid diluted with 8 ounces or more of water, continuing the shaking. Add the eggs one by one and finally make up to 40 ounces with the water.

4.—A good stimulating liniment is made of castor oil, 2 fl.oz.; rape seed oil, 2 fl.oz.; oil of turpentine, 2 fl.oz.; stronger water of ammonia, 3 fl.oz.; water, 3 fl.oz. Mix the oils and add the water and ammonia.

Nasal Gleet (Merritt).—Aloes, 6 drams; nux vomica, 20 gr.; linseed meal, 4 drams. Make into bolus. One every night.—*Am. Drug.*

Physic Balls.—Barbadoes aloes, 2 oz.; powdered ginger, 1 oz.; ol. cloves, 1 dram; soft soap, q. s. to mass. Divide into sizes as required, and bear in mind a pony does not need as much as a heavy cart horse; if pressed for time, the above will mass well with a little soap liniment instead of using soft soap. The balls should be rolled in licorice powder and wrapped, first in waxed paper, paste the edges, then in white paper, the latter to be removed before giving the ball. A bran mash is usually given about two hours after or the next morning.

Pleurisy (Vansant).—Tincture aconite root, 12 drops; tartar emetic, 30 gr.; powdered ginger, 30 gr.; linseed meal, 4 drams. Make into bolus. Give at a dose.

Ringbone (Bell).—1.—Olive oil, 1 oz.; aqua ammonia, 4 drams; oil origanum, 1 oz.; oil turpentine, 1 oz.; oil wormwood, 2 drams; alcohol, 4 oz. Mix. Apply night and morning.

2.—(Pinkard).—Alum, 2 drams; verdigris, 1 oz.; North Carolina wax, 2 oz.; yellow wax, 2 oz.; lard, 4 oz. Mix by aid of heat. Apply twice a day.

Sores, Chafes, etc.—Powdered borax, 1 dram; powdered animal charcoal, ½ dram; oil of tar, 10 m.; oil of camphor, 1 dram; lard enough to make 1 oz.

Spavin.—1.—Corrosive mercuric chloride, 10 gr.; tincture of arnica, 2 oz.; oil of peppermint, 2 oz.; tincture of iodine, 1 pt.

2.—(Baron).—Cantharides, 2 drams; euphorbium, 2 drams; mercury bichloride, 15 gr.; red mercuric oxide, 30 gr.; mercurial ointment, 5 drams; tincture iodine, 2 drams; lard, 3½ oz. Mix by aid of heat. Apply with brush.

3.—(Millican).—Croton oil, 2 oz.; cottonseed oil, 8 oz. Apply heat and gradually add sulphuric acid, 80 m.

4.—(Wickes).—Yellow wax, 1 dram; rosin, 3 drams; cantharides, 90 gr.; charcoal, 2 drams; red mercuric iodide, 2 drams; linseed oil, 4 oz.; lard oil, 4 oz. Mix by aid of heat. Apply with brush.

Worms (Biddle).—Calomel, 1 dram; tartar emetic, 20 gr.; aloes, 4 drams; fenugreek, 4 drams. Make into bolus. Give at night.

WEEDS

Most of the following directions for exterminating weeds are taken from Farmers' Bulletin 28, entitled "Weeds and How to Kill Them," by Lyster H. Dewey:

For the complete eradication of a noxious plant the production of seeds must be prevented, and if the plant is a biennial or a perennial the root, bulb or root stock must be killed.

In the case of weeds that have already

become abundant and widely distributed, their extermination is regarded as almost impossible, but they may be brought under subjection to an extent that will render them comparatively harmless. A new species, if taken in time, may be completely eradicated.

Annuals.—An annual reproduces itself from the seeds only, dying root and branch each year. The seeds of many annuals retain their vitality for several years, and are likely to germinate at irregular intervals, even though no fresh seed is introduced.

Preventing the production of seed will reduce the quantity of weeds and prevent spreading. In cultivated fields burn over the land to destroy as many as possible of the seeds on the surface. Plow shallow so as not to bury the remaining seeds too deeply. The succeeding cultivation, not deeper than the plowing, will induce the germination of seeds in this layer of soil and kill the seedlings as they appear. The land may then be plowed deeper and the cultivation repeated under the weed seeds are pretty thoroughly cleared out to as great a depth as the plow ever reaches.

Barren summer fallowing is often practiced to clear out weedy land by the method just described; but usually corn, potatoes, cotton, cabbages or beets may better be grown, giving a profitable return for the extra cultivation. The best results can be obtained, of course, with crops that allow cultivation during the greater part of the season, and that do not shade the soil too much, as the direct rays of the sun heating the surface of the soil aid materially in the germination of many seeds. Good results have been obtained by spraying with 2 to 4 per cent. solutions of copper sulphate to destroy charlock or wild mustard in growing grain, but the application of chemicals cannot be recommended for killing annual plants where cultivation is possible.

As annual weeds usually thrive best in soil that has been broken but is not occupied, it is evident that broken land should not be permitted to remain idle.

A little grass seed raked in on bare hillsides will often keep down annual weeds and will at the same time prevent washing. Mowing the roadside two or three times during the summer will subdue the dog fennel and ragweed. Mowing the stubble about two weeks after harvest in grain fields that have been seeded to grass or clover will check the annual weeds and at the same time produce a mulch that is very beneficial to the seeding during the August drought.

Biennials.—The best methods for killing the roots or root-stocks vary considerably according to the soil, climate, character of the different weeds and the size of the patch or the quantity to be killed. In general, however, the following principles apply:

1.—The roots, root-stocks, bulbs, etc., may be dug up and removed, a remedy that can be practically applied only in small areas.

2.—Salt, coal oil or strong acid applied so as to come in contact with the freshly cut roots or root-stocks destroys them for some distance from the point of contact. Crude sulphuric acid is probably the most effective of comparatively inexpensive materials that can be used for this purpose, but its strong corrosive properties render it dangerous to handle. Carbolic acid is less corrosive and nearly as effective. Arsenite of soda, a dangerous poison, is sometimes effective, applied as a spray on the growing weeds.

3.—Roots may be starved to death by preventing any development of green leaves or other parts above ground. This may be effected by building straw stacks over small patches, by persistent, thorough cultivation in fields, by the use of the hoe or spud in waste places and by salting the plants and turning on sheep in permanent pastures.

4.—The plants may usually be smothered by dense sod-forming grasses or by a crop like hemp, buckwheat, clover, cowpeas or millet that will exclude the light.

5.—Most roots are readily destroyed by exposing them to the direct action of the sun during the summer drought, or to the direct action of the frost in winter. In this way plowing, for example, becomes effective.

6.—Any cultivation which merely breaks up the root-stocks and leaves them in the ground, especially during wet weather, aids in their distribution and multiplication, and is worse than useless, unless the cultivation is continued so as to prevent any growth above ground. Plowing and fitting corn ground in April and May, and cultivating at intervals until the last of June, then leaving the land uncultivated during the remainder of the season, is one of the best methods that could be pursued to encourage the growth of couch grass, Johnson grass and many other perennial weeds.

Special Weeds Attracting Attention.

Bracted Plantain.—This weed is so low and inconspicuous and its leaves are so much like those of grass that it is not easily discernible until the flower spikes appear. Hand pulling and burning is perhaps one of the best remedies where the plants are not too abundant. If the land has become thoroughly seeded a series of hoed crops will probably be necessary to clear it out. In permanent pasture, mowing the plants as the seed stalks first appear will keep them in subjection. The mowing will have to be repeated several times, however, as the bracted plantain sends up seed stalks from May until November.

The reports concerning this plant indicate that, if unchecked, it is likely to prove as troublesome as the rib grass which has become so widely distributed, chiefly in clover seed. The seeds of the bracted plantain are of nearly the same size and shape as those of the rib grass, and as they ripen throughout the same season—June to November—they are just as likely to be harvested and thrashed with the clover seed.

Buffalo Bur.—An annual, easily subdued by preventing the production of seeds. This may be done by mowing as often as the yellow blossoms appear. The seeds are less abundant than those of most of the bad annual weeds, and they are not often ripe, at least in the northern part of its range, until after the hurrying work of harvest is over. The buffalo bur is seldom troublesome in fields where thorough cultivation is practiced. The seeds may be expected as impurities in alfalfa and clover seed grown in the West. So far as known, however, in the East this weed has appeared first in waste places in cities and towns and has spread thence to the surrounding farms.

Chondrilla.—As the plant is usually most abundant in neglected pasture land where the soil is somewhat impoverished, it seems probable that cultivation and a supply of fertilizer would soon subdue it. Left unchecked it not only occupies all the space where the grass has become thin, but encroaches aggressively on strong grass sod.

Charlock.—At a meeting of the French Society of Agriculture, M. Aime Girard, the celebrated agricultural chemist, announced that cereal fields could be readily freed from the weed, without the least damage being done to the grain, by treating them with a 5 per cent. solution of sulphate of copper. The explanation appears to be that the salt is absorbed by the tissues of the charlock, whereas it does not affect the difficulty permeable cuticle of wheat or oats. A drop of water deposited with suitable precautions on an oat leaf retains its spherical form, and with a little care may even be removed without the leaf being moistened.

On the other hand, a drop placed on a charlock leaf forthwith extends and enters the tissues. The same thing happens when a solution of sulphate of copper is employed. Hence the charlock is poisoned and perishes at once, while the grain escapes. This seems a very simple and cheap method of weeding a field of wheat or oats. If, however, M. Bernard, who took part in the discussion of M. Girard's paper, is not astray in his conclusions, an even simpler and cheaper plan may be pursued by using sulphate of iron instead of the copper salt. He used a mixture of sulphate of iron and water, consisting of 20 or 30 kilograms of sulphate to the hectoliter of water and found that from fields sprinkled with this liquid charlock disappeared entirely, the cereals being uninjured.—*Revue Scientifique.*

False Flax.—Where abundant it may be necessary to omit winter wheat and rye from the rotation for a few years and raise crops that will permit cultivation in autumn. Spring grain crops may be grown, or hoed crops may occupy the ground during the summer. Hoed crops may be employed to best advantage, as the cultivation given to these crops will induce the false-flax seed to germinate and thus clear the land sooner. In pastures and meadows the weeds may be pulled if they have not become too abundant; but if this work has been long neglected it will probably be necessary to plow and cultivate the land.

Horse Nettle.—The production of seed may be prevented by keeping the plants mown. The roots must be killed, however, and this task is about as difficult as killing the root of the Canada thistle; in fact, the methods which are most successful in destroying the Canada thistle may be used with advantage in destroying the horse nettle. Clean cultivation and grubbing or spudding sufficient to prevent any development above ground will starve out the roots. Oats, barley, or millet sown thickly on well-tilled land will weaken the roots, preventing much growth above ground. Immediately after these crops are harvested the land may be plowed and then harrowed frequently until time for sowing crimson clover or winter rye. This will induce the germination of weed seeds, and at the same time expose some of the roots to be killed by the sun. Crimson clover, hairy vetch, rye, or winter oats may be sown to choke down the growth of horse nettle and other weeds during the fall and early spring, to furnish winter pasturage, and then to be plowed under as a green fertilizer. A hoed crop following, if kept well cultivated, will clear out most of the remaining weeds. The plowshare used in these operations should be cut sharp, so as to cut a clean furrow, otherwise the roots are likely to be dragged and scattered about the field.

Spiny Amaranth.—Like other annuals it may be subdued by preventing the production of seed. It would readily succumb to thorough cultivation, as it grows rather slowly at first and does not produce seed until midsummer or later. Mowing or grubbing up the plant before the flower spikes develop is probably the best method of eradication in permanent pastures. Potato land and corn stubble may be plowed or thoroughly disked after the crop is harvested and a winter crop sown which will keep down the weeds.

Spiny Cocklebur.—The growth at first is slow and, as it needs light and room to develop into a robust plant, it may be choked down by any quick-growing crop that will crowd and shade it. In permanent pastures and waste places, where it flourishes best, it could doubtless be eradicated in time by mowing the plants about twice each year, in August and September, or by cutting them up with a hoe or spud in May and June. As the seeds often lie dormant in the thick-walled bur several years before germinating, it might require a like period to exterminate a patch by this method; but the plants would continually be growing less in number, and the labor correspondingly lighter.

Prickly Lettuce.—Sheep and sometimes cattle will eat the young prickly lettuce, and their services have been found very effective, especially in recently cleared land where thorough cultivation is impossible. Repeatedly mowing the plants as they first begin to blossom will prevent seeding and eventually subdue them. Thorough cultivation with a hoed crop, by means of which the seed in the soil may be induced to germinate, will be found most effective. The first plowing should be shallow, so as not to bury the seeds too deep. Under no circumstances should the mature seed-bearing plants be plowed under, as that would only fill the soil with seeds buried at different depths to be brought under conditions favorable for germination at intervals for several years. Mature plants should be mowed and burned before plowing. The seed appears as an impurity in clover, millet, and the heavier gross seeds, and the plant is doubtless most frequently introduced by this means. As the seed may be carried a long distance by the wind the plants must be cleared out of fence rows, waste land, and roadsides.

Wild Carrot.—In permanent pasture the persistent mowing of the plants as often as the flower appears will eventually destroy them. They will continue to branch out from the base after each cutting until finally exhausted, so that the first mowing will often appear to increase rather than diminish their numbers. The root may be cut off with a spud some distance below the surface of the ground, a process that usually kills them at once. Pulling the plant by hand when the ground is wet, although somewhat laborious, is one of the surest methods of eradication. Sheep eating the young plants will aid considerably in keeping them down. The wild carrot is seldom troublesome in cultivated fields, which indicates that even moderate cultivation will partly subdue it, and that thorough cultivation, accompanied by the destruction of the weeds in waste places, would reduce it to comparative harmlessness.

Wild Oat.—The grain retains its vitality much longer than does the common oat, and may remain buried in the soil several years without germinating. It germinates best when there is an abundance of moisture and the soil is warm. To clear the seed out of the soil, therefore, the land should be stirred when it is warm and as moist as will permit good cultivation. It is understood, of course, that cultivating the land when wet, especially in clay soils, is bad policy, and it is advocated in this case only for a special purpose. The clearing of the soil can be accomplished in conjunction with the cultivation of corn or root crops. Where winter wheat and rye may be grown profitably the land should be plowed as soon as possible after the spring crop is harvested, and harrowed about once a week until time for sowing the wheat or rye. Oats should be left out of the rotation so far as may be until the wild oats are subdued, as the latter growing among the cultivated oats are difficult to detect for removal, and after harvesting and thrashing it is practically impossible to separate completely the two kinds of grain. In other grain crops the wild oat may be pulled or cut and removed by hand before maturity in the same manner as wild mustard or rye. Where it is very abundant, however, this plan would be too laborious to pursue with profit, and the crop would better be mown for hay or plowed under. No. oats should be sown coming from farms where the wild oat is known to grow.

Weeds in Walks, Lawns, Etc.

Grass between Bricks in a Wall.—After cleaning out the seams to a depth of a quarter of an inch, scatter a little powdered commercial bluestone and then lightly sweep it over, so as to leave a little powder in the cracks. When this is washed in by the rain, it will prevent vegetable growth and not appreciably stain the brick. A pound of bluestone, costing not over ten cents, will suffice for fifty or more yards of paving, and last for years.

Lawns.—The plants should be cut off close to the ground and a few drops of coal oil poured on to the crowns. They immediately commence to decay and are utterly destroyed. Troublesome weeds on the lawn can thus be speedily disposed of, but others will likely take their place.

Walks.—1.—The best way, says a correspondent, to apply salt to paths to destroy weeds, is as follows: Boil the salt in water, one pound to one gallon, and apply the mixture boiling hot with a watering pot that has a spreading rose; this will keep weeds and worms away for two or three years. Put one pound to the square, yard the first year; afterward a weaker solution may be applied when required.

2.—Arsenic trioxide, 6 lb.; copper sulphate, 2 lb.; sodium hydroxide, 2 lb.; potassium nitrate, 1 lb.; sulphur, 1 lb.; ammonium chloride, 1 lb. Use 5 to 10 pounds to 30 gallons of water.

3.—Gas Liquor.—Pour out a few times in succession and do not touch the tree roots and borders of the paths. This medium is cheap.

4.—Rock Salt.—Throw out repeatedly.

5.—Hydrochloric Acid.—The use of hydrochloric and sulphuric acids is somewhat expensive. Mix 60 liters of water with 10 kilos of unslaked lime and 1 kilo of sulphuric acid in a kettle, and sprinkle the hot or cold mixture on the walks by means of a watering-pot.

6.—Lime Milk.—1 kilo of unslaked lime in 10 liters of water. If used alone it must be fresh.

7.—Among the varieties of gravel, lead gravel is best adapted for garden walks, since it hinders the growth of weeds greatly.

8.—To kill blue grass growing between bricks around the lawn, wash the bricks with salt water or strong solution of soda.

CHAPTER III

ALLOYS AND AMALGAMS

This subject is elaborately indexed, and the reader should consult the Index in all cases. SOLDERS from the subject of a special chapter.

BRIEF SCHEME OF CLASSIFICATION

- GENERAL INFORMATION ON ALLOYS
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GENERAL INFORMATION ON ALLOYS

An alloy is a combination of two or more metals. It is now largely believed that the metals form combinations rather than mixtures, though one of the best metallurgists in England called his book on alloys "Mixed Metals." Hiorn's definition of an alloy, from "Mixed Metals," is given below:

"*Nature of Alloys.*—When two or more metals are caused permanently to unite, the resulting mixture is termed an alloy. When murcury is an essential constituent, the mixture is termed an amalgam. The general method of effecting combination is by the agency of heat, but with certain soft metals true alloys may be formed by subjecting the constituents to considerable pressure, even at the ordinary temperature. Alloys such as those briefly referred to were doubtless first discovered by the metallurgical treatment of mixed ores, from the simultaneous reduction of which alloys would be formed; or, in some cases, as in ores of gold and silver, naturally formed alloys would be obtained by a simple melting process. The direct preparation of alloys by the simple melting together of the constituent metals has been enormously developed in modern times, and the attention which mixed metals are now receiving by chemists is far greater than in any period of history. Comparatively few of the metals possess properties such as render them suitable to be employed alone by the manufacturer; but most of them have important applications in the form of alloys. Even among the metals which can be used independently, it is often found expedient to add portions of other metals to improve or otherwise modify their physical properties. Thus gold is hardened, and made to resist wear and tear, as well as to lower its cost, by the addition of copper; silver is likewise hardened by alloying it with copper; and the bronze coinage is formed of an alloy of copper, zinc and tin for similar reasons."

Alloys generally possess characteristics unshared by their component metals. Thus, copper and zinc form brass, which has a different density, hardness and color from either of its constituents. Whether the metals tend to unite in atomic proportions, or in any definite ratio, is still undetermined. The evidence afforded by the natural alloys of gold and silver, and by the phenomena accompanying the cooling of several alloys from the state of fusion, goes far to prove that such is the case. (Rudberg.) The subject is, however, one of considerable difficulty, as metals and metallic compounds are generally soluble in each other, and unite by simple fusion and contact. That they do not combine indifferently with each other, but exercise a species of elective affinity not dissimilar to other bodies, is clearly shown by the homogeneity and superior quality of many alloys in which the constituent metals are in atomic proportion. The variation of the specific gravity and melting points of alloys from the mean of those of their component metals, also affords strong evidence of a chemical change having taken place. Thus, alloys generally melt at lower temperatures than those required for their separate metals. They also usually possess more tenacity and hardness than the mean of their constituents.

Matthiessen found that when weights are suspended to spirals of hard-drawn wire made of copper, silver, gold, or platinum, they become nearly straightened when stretched by a moderate weight; but wires of equal dimensions, composed of copper-tin (12% of tin), silver-platinum (36% of platinum), and gold-copper (84% of copper), scarcely undergo any permanent change in form when subjected to tension by the same weight.

The same chemist gives the following approximative results upon the tenacity of certain metals and wires hard drawn through the same gauge (No. 23): Copper, breaking strain for double wire, 25 to 30 lb.; tin, breaking strain for double wire, under 7 lb.; lead, breaking strain for double wire, under 7 lb.; tin-lead (20% lead), breaking strain for double wire, about 7 lb.; tin-copper (12% copper), breaking strain for double wire, about 7 lb.; copper-tin (12% tin), breaking strain for double wire, about 80 to 90 lb.; gold, breaking strain for double wire, 20 to 25 lb.; gold-copper (8.4% copper), breaking strain for double wire, 70 to 75 lb.; silver, breaking strain for double wire, 45 to 50 lb.; platinum, breaking strain for double wire, 45 to 50 lb.; silver-platinum (30% platinum), breaking strain for double wire, 75 to 80 lb. On the other hand, their malleability, ductility, and power of resisting oxygen is generally diminished. The alloy formed of two brittle metals is always brittle; that of a brittle and a ductile metal, generally so; and even two ductile metals sometimes unite to form a brittle compound. The alloys formed of metals having different fusing points are usually malleable while cold, and brittle while hot. The action of the air on alloys is generally less than on their simple metals, unless the former are heated. A mixture of 1 part of tin and 3 parts of lead is scarcely acted on at common temperatures; but at a red heat it readily takes fire, and continues to burn for some time like a piece of bad turf. In like manner, a mixture of tin and zinc, when strongly heated, decomposes both moist air and steam with almost fearful rapidity.

The specific gravity of alloys is never the arithmetical mean of that of their constituents, as commonly taught; and in many cases considerable condensation or expansion occurs. When there is a strong affinity between two metals, the density of their alloy is generally greater than the calculated mean, and *vice versa*, as may be seen in the following list:

Alloys the Density of which is Greater than the Mean of their Constituents.—Gold and zinc; gold and tin; gold and bismuth; gold and antimony; gold and cobalt; silver and zinc; silver and tin; silver and bismuth; silver and antimony; copper and zinc; copper and tin; copper and palladium; copper and bismuth; lead and antimony; platinum and molybdenum; palladium and bismuth.

Alloys the Density of which is Less than the Mean of their Constituents.—Gold and silver; gold and iron; gold and lead; gold and copper; gold and iridium; gold and nickel; silver and copper; iron and bismuth; iron and antimony; iron and lead.

Preparation and Properties of Alloys.—The mode of procedure in the production of any alloy will be largely influenced by the nature of the metals to be operated upon. Some metals are volatile, and readily pass off as vapor when heated a few degrees above their melting points. Others have little tendency to vaporize, and may be raised to high temperatures without sensible volatilization. When a volatile metal has to be alloyed with a non-volatile metal, and the fusing points of both are approximately the same, combination can be most readily effected by mixing the constituents and melting them together in the same crucible or furnace. This is, however seldom the case, and as a general rule, the components of an alloy, one or all of which are volatile, have widely divergent melting points, and then it is requisite for the most refractory constituent to be melted first, and for the others to be added in the solid state. Again, an alloy may contain one or more fixed metals and a volatile one, in which case the more volatile metal is added to the crucible after the fixed metal or metals have been fused, and raised to a temperature necessary to melt the volatile constituent immediately it is introduced, so that combination may be effected before any serious loss, due to vaporization, has occurred. Union between the components of an alloy is more perfectly secured by agitation of the contents with a stirring-rod, the most effective in many cases being a wooden or carbon rod, which promotes admixture without the introduction of any substance likely to contaminate the mixture and modify its properties.

A thing to be guarded against in the melting of all base metals, or alloys containing base metals as essential constituents, is oxidation. Various plans are adopted to avoid loss of metal and injury to the alloy from this cause. The most common one is to cover the metals with carbon, which not only excludes the air admitted to the furnace, but tends to absorb any oxygen liberated from the metals during fusion. The gas thus formed by union of carbon with oxygen is termed carbonic oxide (CO), and this gas being a reducing agent, is capable of taking up another atom of oxygen, forming carbonic acid (CO_2). Thus, as long as the mixture is covered with carbon, the carbonic oxide formed effectually shields it from oxidation. In the method already referred to of stirring metals with a carbon rod to promote mixture, the same gas, carbonic oxide, is formed, and thus the rod not only promotes union by mechanical agitation, but generates a gas which protects the metals in a great measure from oxidation. In some cases this is not admissible, as commercial metals are impure, and it may be advisable to admit sufficient oxygen, either from the air or by means of a special oxidizing agent, added along with the flux, to convert the impurities into oxides, which do not alloy with the metals, but either enter into combination with the flux to form a slag, or rise to the surface as dross or scum. In most cases it is advisable that the covering body should not exert any influence on the metals beneath.

Some manufacturers are in the habit of throwing fat and rosin on the heated metals before fusion. These are decomposed by heat, liberating gases, and when well stirred with the molten metal promote combination by the mechanical agitation imparted by their escape. They also act chemically in removing oxygen, by the union of that element with the carbon and hydrogen set free. When the evolution of gas has ceased a quantity of carbon remains in a finely divided state, which covers the metals and protects them from oxidation.

Borax is sometimes used to exclude the air, but it is much more costly than carbon, and when it is not required as a flux its employment is accompanied with some evils. Now, borax is composed of the base soda in combination with boric acid, which is only partly saturated with the soda, and the excess of acid unites with any metallic oxide present, forming double borates of a glassy nature. Commercial borax is often very impure, and is adulterated with common salt and alum; these impurities are injurious to many metals. Sodium chloride, or common salt, is also employed for preserving molten metals from oxidation, and also to moderate the action of bodies which cause violent ebullition. Glass is frequently used for a similar purpose, and, next to carbon, is the least injurious to metals. It is a mixture of silicates, which easily fuses at high temperatures, forming compounds with lime and other bases, so that it acts almost as beneficially as borax when such a flux is required. Window glass or green bottle glass is the most useful, but flint glass, which contains much oxide of lead, would be detrimental in many cases.

The nature of metallic alloys has already been discussed, from which we may assume that certain proportions of the constituents enter into chemical combination, and other portions are simply in a state of mixture or solution, and, therefore, on gradually cooling, tend to separate in distinct layers, according to their respective densities. This is especially the case when the constituents have widely divergent densities, so that the higher the temperature of the alloy when removed from the furnace the longer will the period of cooling last, and the greater will be the facilities offered for separation. To obviate this defect, the metal should be constantly agitated by stirring, or otherwise, and poured into the molds at the lowest temperature consistent with the requisite fluidity, and cooled as rapidly as the nature of the alloy and the purpose for which it is designed will admit. With regard to the melting point of an alloy, it should be borne in mind that it fuses at a lower temperature than that at which the most refractory constituent melts, and sometimes below that of either, which knowledge should guide the operator in so regulating the temperature as not to make the charge unnecessarily hot.

It is a well-known fact that the character of many alloys is altered by repeated remelting, and that the scrap obtained in working cannot be used again without the addition of a certain quantity of new metal. A given mixture may be employed for the formation of an alloy, which is highly malleable, ductile, and tenacious, and the scrap from the same alloy, when remelted, may be brittle and unworkable; but when a suitable quantity of new metal is added, the combination may form an alloy even superior to the original one with regard to its good working properties. It is to the advantage of the manufacturer, as regards economy, to use as much scrap as possible in alloying, and the quantity thus employed varies from one-third to two-thirds of the weight of the charge. Of course, in using old metal, many more impurities are liable to be introduced than with new metal, and although the same impurities may exist in the new metal, the quantities may be insufficient to produce a deteriorating effect, but when augmented from old metal may then rise to such proportions as to entirely alter the physical properties of the alloy. The presence of notable quantities of foreign matter is generally exhibited by increased hardness and a modification of the structure, as seen on a freshly fractured surface.

The difficulty of maintaining uniformity in an alloy after repeated remelting is least when only two metals are mixed together, and increases when the combination requires the presence of three or more metals. Thus German silver requires much greater care in this respect than brass; and soft solder, containing only lead and tin, requires less care than fusible alloy, containing bismuth or cadmium in addition to lead and tin. Those alloys which contain as an essential constituent a volatile metal, such as zinc or antimony, are generally altered most by remelting, and it is requisite to know, at any rate approximately, what the furnace loss is, so that the defection may be counterbalanced by the addition of the quantity of fresh metal requisite to maintain the right composition. Many errors arise from this cause, as well as from overdoing what is required. Where possible, a chemical analysis is the best means of solving the problem, but as this is out of the question in most cases, a few simple trials with weighed quantities, and careful observation of the results obtained, by testing its malleability, color and fracture, will generally afford sufficient evidence of the required amount to be added.

In making experimental tests, a small melting furnace, such as that used in a metallurgical laboratory, a strong pair of hand rolls, and an anvil, would be very useful adjuncts to every casting shop. The quantity of metal operated upon need not exceed one pound in weight, and as this could be cast in a long strip, its suitability for stamping or rolling could be readily tested. Such test pieces, if carefully labeled and preserved, would be most valuable for future reference, and there can be no doubt that both employers and employed would thus gain a vast amount of information which would prove of great benefit both as a standard of workmanship and of economy of production. It is a great annoyance to find, after a quantity of metal has been mixed, and the castings made, that the alloy is unsuitable for the work required of it, either from unsuitable constituents, improper mixing, or impure materials; which annoyance could be avoided by a few preliminary trials on a small scale. The casting of such trial tests could be made in an iron or sand mold, and the time of cooling made to approximate to that of a large mass by judicious treatment. Another advantage of such an experimental plant would be that new combinations could be readily tried, and the effect of certain impurities on well-known alloys ascertained, by purposely adding these bodies in definite amounts to a weighed quantity of the alloy.

It has been observed that cold working of metals often produces an augmentation of strength. Le Chatelier finds that there is a limit to the increase of strength obtained by the cold working of pure metals or of those containing less than 1 to 2% of impurities. For all metals examined, excepting silver, and maximum strength after cold working is double that of the perfectly annealed specimens. In the case of alloys, some follow the same law as pure metals; others, such as bronze, copper-silver alloys, and aluminum bronze, become more and more brittle after each successive draw without annealing, and the strength increases regularly, but at last the metal becomes too brittle to the further worked, and gives way.

In regard to annealing, five laws are formulated as the result of experiments; (1) Annealing is never instantaneous; its effects, rapid at first, become more and more slow, and the softening tends toward a limit for each temperature; (2) this limit is lower, and is attained more rapidly as the annealing temperature is raised; (3) above a certain temperature annealing is complete, and a further increase of temperature does not diminish the strength, but a crystallization due to annealing occurs, and increases with the time of annealing, ultimately reducing the tensile strength and elongation to those of the cast metal; (4) the presence of impurities retards the action of annealing, and demands a higher temperature for its completion; (5) the crystillization from annealing is due to the presence of impurities which have lower fusing points than the metal itself, or which form compounds which have those properties.

Cold-worked metals tend to recover their malleability even at ordinary temperatures by a process which Le Chatelier terms spontaneous annealing. The maximum limit of strength attainable by cold working is reached at the moment when the increase produced by continued working is just balanced by the diminution due to spontaneous annealing. Similarly, in wire-drawing, if the thickness of the metal be reduced too rapidly by successive passes without annealing, it will break, owing to the failure of the spontaneous annealing to keep pace with the distorting force; but the metal may be fractured even in course of a very gradual reduction, unless it be allowed to remain at rest for 5 or 10 minutes between the passes; with this precaution, however, it may be drawn down indefinitely, even without heating. Spontaneous annealing affects the mechanical properties of metals under test, causing the breaking load at any given temperature to be greater in proportion to the rapidity with which the stress is applied, while the deformation produced is not instantaneous, but increases more and more slowly up to a certain limit.

The purposes for which alloys are required are endless. Some are required to possess great malleability, for others hardness is the chief requisite; others, again, must possess a high degree of elasticity, while some are useful on account of their low melting point, etc. These different demands can only be satisfied by uniting suitable metals in different proportions.

The metals most often used for alloying at the present time are those which have been known the longest, such as copper, zinc, lead, tin, gold and silver; and although combinations of these metals have been known and employed for many centuries, it is only during the latter half of the nineteenth century that their intimate properties have been closely studied. Indeed, at the present day our information concerning the nature and properties of alloys is perhaps less than in any other branch of chemical science, and although chemical investigation may do much to enlighten our knowledge, such information will be destitute of great commercial value unless accompanied with practical knowledge of the working, from observation of the physical properties, when alloys are worked in large quantities by the manufacturers themselves. The number of simple metals is very limited, but they may be united in various proportions, forming an endless variety of modifications; and since every alloy may be looked upon as a new metal, from the fact of its properties differing from those of its constituents, we have at command the necessary material for producing metals suitable for every requirement for which metallic matter is desirable. The action of metals upon each other is widely divergent; sometimes one metal may be added to another in quantity without seriously altering its working properties; in other cases a minute quantity of the second metal will altogether change the character of the first metal; so that in alloying, it by no means follows, because one metal may be freely added, that another, even of a similar nature, may be as liberally introduced. The man who aspires to the formation of new alloys, or who wishes to produce metals suitable for different requirements, as circumstances arise, must be well acquainted with the nature and properties of the simple metals in order to successfully accomplish his object; and although a knowledge of the components is not sufficient of itself, it is of immense advantage in assisting the operator who combines practical experience in mixing metals with this theoretical knowledge. It is for these reasons that a brief account of the elementary metals is included in this work.

In chemical combination it is a well-known fact that elements always combine with other elements in definite proportions by weight, termed atomic weight, producing compound of fixed and decided properties, so that the same compounds can be always relied upon to contain the same elements, united in the same proportions. The same law applies to the union of two metals, when such metals are chemically combined, and the same alloy will always have properties identically the same, however it may be tested. Several experimenters have directed their attention to the mixing of metals according to their atomic weights, so as to obtain alloys of determined characteristic properties, but up to the present time the number of such combinations of a useful character is very limited. They are by no means the ones most suited to the wants and requirements of industry. There is always one indispensable item, from the manufacturer's point of view, which the chemist is not concerned with—that is, the cost of production—and however nicely atomic proportions would suit the requirements of a given alloy, such an alloy would, in most cases, be useless unless the cost was consistent with the market value. The question, then, of cost must have consideration, and the proportions must, if possible, be made to fit in with commercial necessities. With regard to copper alloys, such as brass and bronze, the combinations which best exhibit the characters of chemical compounds are hard and brittle, and as copper alloys are much more widely used than any other, there is little inducement to encourage metallurgists to endeavor to alloy copper and zinc, or copper and tin, in atomic proportions, since malleability and tenacity are the properties most desired in these alloys. Again, color is the chief desideratum in many alloys, and this cannot be always obtained by mixing in atomic proportions, especially as it often happens that a very small addition of one of the constituents will alter the shade of color so as to produce what is required.

When it is desirable to add a non-metallic element to a metal or alloy, for the purpose of bringing about a certain result, very much greater care is generally required in apportioning the quantity to be added than with a metal, as non-metals combine much more actively with metals than the metals do with each other, and a very small quantity of a non-metal will suffice to alter the properties of a metal or alloy. It is very surprising to note how, in some instances, a mere trace of another element will alter the properties of a metal. For example, 1-2000 of carbon added to iron will convert it into mild steel; 1-1000 of phosphorus makes copper hot-short; 1-2000 part of tellurium in bismuth makes it minutely crystalline; 1-1000 part of bismuth in copper renders it exceedingly bad in quality for certain purposes.

Lothar Meyer has shown that a remarkable relation exists between the "atomic volumes of the elements." The relative atomic volumes of the elements are found by dividing their atomic weights by their specific gravities. The atomic weight of lead is 207, and its specific gravity 11.45; 207 ÷ 11.45 = 18, the atomic volume of lead. It would appear that the power of an element to produce weakness in a metal, when added in small quantity, is dependent on the atomic volume of the impurity. Roberts-Austen tried the effect of various elements on pure gold, and found that when the body added had an atomic value equal to or less than that of gold the strength was little affected, and in some cases, as copper, for example, was increased; but when the element added had an atomic volume much greater than that of gold the strength, with two exceptions, was greatly diminished.

Fusibility.—Some metals are almost infusible, and when heated to the highest heat in a crucible they refuse to melt and become fluid; but any metal can be melted by combination with more fusible metals. Thus platinum, which is infusible with any ordinary heat, can be fused readily when combined with zinc, tin or arsenic. This metal, by combination with arsenic, is rendered so fluid that it may be cast into any desired shape, and the arsenic may then be evaporated by a mild heat, leaving the platinum. Nickel, which barely fuses alone, will enter into combination with copper, forming German silver, an alloy that is more fusible than nickel and less fusible than copper. The less fusible metals, when fused in contact with the more fusible metals, seem to dissolve in the fusible metals; rather than melt, the surface of the metal is gradually washed down, until the entire mass is dissolved or liquefied, and reduced to the state of alloy.

Following are the melting points of the elements employed in alloys:

	Degrees Cent.
Aluminum	654.5
Antimony	629.5
Arsenic	450

(Fusibility of Alloys)

	Degrees Cent.
Bismuth	268.3
Cadmium	320
Copper	1080.5
Gold	1061.7
Iron	1550-1600
Lead	330- 335
Magnesium	632.7
Manganese	1800-1900
Mercury	39.4

(Table of Alloys)

	Degrees Cent.
Nickel	1400-1450
Phosphorus	44
Platinum	1775
Silicon	1100-1300
Silver	960.5
Sulphur	114.5
Tellurium	282
Tin	231.68
Zinc	419

Table of Alloys

The following is a table of the proportions of the various metals in the alloys most commonly employed in the arts and manufactures. The term "parts" means parts by weight. The abbreviations are: Cu, copper; Zn, zinc; Sn, tin; Pb, lead; Sb, antimony; P, phosphorus; As, arsenic; Ni, nickel.

Description.	Cu.	Zn.	Sn.	Pb.	Sb.	P.	As.	Ni.
1. Metal for frictional parts of locomotives (extremely hard)	87	5	8	..	..	..	..	..
2. Bearings of carriages	97	3	..	..	..	..	..	..
3. Bearings of driving wheels, also for steam engine whistles, giving a clear sound	80	2	18	..	..	..	..	..
4. Steam engine whistles giving a deep sound	81	2	17	..	..	..	..	..
5. Cross heads of connecting rods	82	2	16	..	..	..	..	..
6. Cylinders of pumps, valve boxes, and taps	88	2	10	..	..	..	..	..
7. Eccentric collars	84	2	14	..	..	..	..	..
8. Bearings of axles and trunnions; eccentric collars	84	2	14	..	..	..	..	..
	85	2	13	..	..	..	..	..
	84	7	9	..	..	..	..	..
	68	4	28	..	..	..	..	..
9. Pistons of locomotives	88	9	3	..	..	..	..	..
	84	8.4	2.9	4.7	..	..	..	..
10. Axle boxes	88	2	10	..	..	..	..	..
11. Mathematical instruments, arms of balances	90	2	8	..	..	..	..	..
12. Machinery, bearings, etc	67	..	14	19		..	..	..
13. Steam engine whistles	30	..	18	..	2	..	..	..
14. Metal to withstand friction (Stephenson)	79	5	8	8	..	..	..	..
15. Rivets	64	24.6	3	9	..	..	..	..
16. Metal for coffins	15	..	40	45		..	..	..
17. Metal to withstand friction	2		72	..	26	..	..	..
18. Cylinders of pumps	7	72	21	..		..	..	..
19. Metal for bearings of locomotives	2	..	90	..	8	..	..	..
20. White brittle metal (for buttons, etc.)	10	6	20	..	64	..	..	..
21. Imitation silver	64	..	3	..	..	..	..	..
22. Pinchbeck	5	1	..	..	..	..	..	..
23. Tombac	16	1	1	..	..	..	..	..
24. Red tombac	10	1		..	..	..	..	..
25. Specially adapted for bearings	83	..	15.5	..	1.5		..	..
26. For bearings and valves	83.25	..	7	9		0.75	..	..
27. Electrotype "backing metal"	..	..	4	91	5	..	..	..
28. Stereotype metal for paper process	..	..	..	88	12	..	..	..
29. „ „ „ plaster process	..	..	..	82	18	..	..	..
30. Bullet Metal			..	92	..	..	2	..
31. Malleable brass plate	67	33	..	0.5	..	..	..	..
32. Pin wire	67	33	0.5	0.5	..	..	..	..
33. Jemmapes brass	64.6	33.7	0.2	1.5	..	..	..	..
34. Similor for gilding	92.7	4.6	2.7	..	..	..	..	..
35. Maillechort for rolling	60	20	..	..	..	..	..	20
36. „ first quality	8	3	..	..	..	..	..	4
37. White similor	7	..		..		..	0.5	..
38. For stopcock seats	..	..	86	..	14	..	..	..
39. „ „ plugs	..	..	80		20	..	..	..
40. For keys of flutes, etc.	..	..	..	20	40	..	..	..
41. Hard tin	..	..	1	..	0.5	..	..	..
42. White tombac	75		25	..	..	..	..	..
43. Vogel's alloy for polishing steel	8	1	2	1	..	..	..	..
44. Rompel's anti-friction metal	62	10	10	18	..	..	..	..
45. Arguzoid, a tough alloy superior to brass	56	23	4	3.5	..	..	..	13.5

ALUMINUM

General Remarks.—Aluminum unites readily with all the common metals except lead. The useful alloys of aluminum so far found may be divided into two classes: the one, of aluminum with not more than 35% of other metals; and the other, of metals containing not over 15% aluminum. In the one case the metals impart hardness and other useful qualities to the aluminum; and in the other the aluminum adds useful qualities to the metals with which it is alloyed.

Alkali Metals.

Because of the ease with which these alloys are decomposed, especially when subjected to water or moist air, none of them can be considered in any way advantageous; in fact, alloys of metallic sodium and potassium with aluminum are the *bete noir* of the metallurgy of aluminum, just as sulphur and phosphorus are feared in the metallurgy of steel.

Antimony.

These metals unite with difficulty, and only in bearing metals of the class of Babbitt metals have any useful alloys as yet been discovered.

Arsenic.

No specially advantageous compounds of these metals have yet been discovered, nor from the nature of the case are they likely to be, although the metals can readily be alloyed.

Bearing Metal.

Additions of ½ to 2% of aluminum to bearing metals tend to free from oxide, producing an improved quality of bearing metal.

Bismuth.

These two metals combine easily, the alloys being very fusible, as might be expected of alloys with bismuth. They remain unchanged in the air at ordinary temperatures, but oxidize rapidly when melted. Bismuth makes aluminum very brittle. No valuable alloys of these two metals have as yet been discovered.

Cadmium.

These metals have been alloyed to produce to solder for aluminum which seems to give good results. Cadmium does not appear to act as a hardener for aluminum, as almost all other metals do.

Cobalt.

Cobalt also acts with about an equal amount of copper, as a specially good alloy for hardening aluminum. The following are two cobalt and aluminum alloys used for special purposes: Cobalt, 60 parts; aluminum, 10 parts; copper, 40 parts. Cobalt, 35 parts; aluminum, 25 parts; iron, 10 parts; copper, 30 parts.

Chromium.

Chromium, though rather expensive, is an especially good hardener of aluminum. Aluminum hardened with chromium seems to retain its hardness after annealing or after being subjected to heat, better than any other of the alloys.

Copper.

Copper Aluminum.—1.—Aluminum is a metal whose properties are very materially influenced by a proportionately small addition of copper. Alloys of 99% of aluminum and 1% of copper are hard, brittle, and bluish in color; 95% of aluminum and 5% of copper gives an alloy which can be hammered, but with 10% of copper the metal can no longer be worked. With 80% and upward of copper are obtained alloys of a beautiful yellow color. The 10% alloys are of a pure golden yellow color; with 5% of aluminum they are reddish yellow, like gold heavily alloyed with copper; and a 2% mixture is of an almost pure copper red. As the proportion of copper increases the brittleness is diminished, and alloys containing 10% and less of aluminum can be used for industrial purposes, the best consisting of 90% of copper and 10% of aluminum. The useful copper alloys with aluminum can be divided into two classes—the one containing less than 11% of aluminum and the other containing less than 15% of copper. The first class is best known as "aluminum bronze."

a.—Aluminum Bronze.—None but the purest copper should be used, and the aluminum should be at least 99% pure. The copper should be put in a plumbago crucible and melted over a gas or oil fire, these being the best fuels to use. Next to gas or oil comes coke or charcoal as a fuel for melting. It is impossible to make satisfactory aluminum bronze over an ordinary coal fire, for the reason that the copper will absorb the gases from the coal. The copper should be covered with charcoal to prevent oxidation and the absorption of gases as much as possible. After the copper has been melted the percentage of aluminum which it is desired to add should be dropped into the pot through the charcoal. In large pots of bronze, the pot may be removed from the fire before adding the aluminum. As soon as the aluminum goes into the pot the first action will be a cooling one, caused by the temperature of the aluminum added. As soon as the aluminum is heated to its melting temperature it combines with the copper. Consequently, a great deal of latent heat is set free, or made sensible, by the chemical union of these two metals; and as a result the temperature of the mass is raised. If the mixture is watched, one can tell as soon as union takes place, because the copper will become more liquid, and also will turn a little brighter. This lasts only an instant after the aluminum is introduced; then the crucible, if it has remained in the furnace, should be removed instantly from the fire, the charcoal should be skimmed from the surface, and the contents, which are now aluminum bronze, should be poured into molds of convenient size. The liquid should be stirred as much as possible till poured. The aluminum bronze, thus made, is ready to remelt for the production of finished castings.

After aluminum bronze is made it improves with each successive remelting and casting until it has been recast three or four times. The remelting seems to give the aluminum a better chance to become more freely disseminated, to form a more uniform alloy with the copper. After putting the aluminum into the crucible, and before pouring, the molten mass should be stirred, in order to insure that the aluminum is as well disseminated through the alloy as possible.

The percentage of aluminum in aluminum bronze varies from a few per cent. up to 10 or 11%, depending upon the purpose for which the alloy is intended. The strongest mixture contains between 10 and 11% of aluminum. Aluminum bronze can be readily soldered. It does not present the difficulty in soldering which pure aluminum does. The best method of soldering aluminum bronze is to use pure block tin with a flux of zinc filings and muriatic acid. It is well to "tin" the two surfaces before putting them together.

A very small amount of aluminum in copper reduces its conductivity for electricity considerably. Deville states that 2 to 3% alloys are used by M. Christophle for large castings of works of art. They are harder than aluminum, and work well under the "burin" and chisel.

The alloy is composed of 90 parts of copper and 10 parts of aluminum. It is a definite chemical compound, and was discovered by Dr. Percy.

The 10% alloy is very hard, can be beaten when cold, but with remarkable perfection when hot, and may be well compared to iron, which it resembles in all these physical properties; it is also very ductile. It behaves as a true alloy, and consequently will not liquate into different combinations. This is proved by the fact that, when in making the alloy, the *pure copper* is in the crucible, and a bar of aluminum is added, the combination takes place with such disengagement of heat that if the crucible is not of good quality it will be fused, for the whole attains a white heat. The hardness of this alloy approaches that of the genuine bronzes, whence its name. It can be stretched out into thin sheets between rollers, worked under the hammer, and shaped as desired by beating, or pressure in powerful stamping presses. On account of its hardness it takes a fine polish, and its peculiar greenish-gold color resembles that of gold alloyed with copper and silver together. Alloys with a still greater proportion of copper approach this metal more and more nearly in their character; the color of an alloy, for instance, composed of 95% of copper and 5% of aluminum, can be distinguished from pure gold only by direct comparison, and the metal is very hard and also very malleable.

Aluminum bronze is not affected by exposure to the air, and its beautiful color makes it very suitable for manufacturing various ornamental articles, including clock cases, doorknobs, etc.

Aluminum-bronze wire is as strong as good steel wire, and castings made from it are as hard as steely iron. Its resistance to bending or sagging is three times as great as that of ordnance metal, and 44 times as great as that of good brass. These properties, combined with its beautiful color and its unchangeableness, would seem to promise a very extended use for it in the manufacture of machinery, and especially for mechanical instruments where great precision is required.

According to a French authority, an alloy of the following composition gives the best results: Copper, 89 to 98%; nickel, 1 to 2%, and aluminum. Aluminum and nickel change in the opposite way; that is to say, in increasing the percentage of nickel the amount of aluminum is decreased by the equal quantity. It should be borne in mind that the best ratio is: aluminum, 9.5%; nickel, 1 to 1.5%, at most. In preparing the alloy, a deoxidizing agent is added, viz., phosphorus to 0.5%, magnesium to 1.5%. The phosphorus should always be added in the form of phosphorus-copper or phosphor-aluminum of exactly determined percentage. It is first added to the copper, then the aluminum and the nickel, and finally the magnesium, the last named at the moment of liquidity, are admixed.

b.—Boron Bronze.—This alloy, or, more correctly speaking, aluminum-boron bronze, is brought about by the introduction of aluminum containing boron, not as aluminum boride, but existing as graphite does in cast iron. Commercially, this part of the process is accomplished by heating in a specially constructed oxy-hydrogen furnace an admixture of fluorspar and vitrified boric anhydride, until the dense fumes of boron fluoride commence to appear. At this stage, ingots of aluminum are introduced into the liquid mass; reduction at once takes place, with the formation of free boron, which dissolves in the aluminum, rendering it crystalline and somewhat brittle. When this so prepared aluminum is alloyed with copper, to the extent of from 5 to 10%, a bronze is obtained denser and more durable than ordinary aluminum bronze, and free from brittleness; but the most peculiar property is the perfectness with which it casts and melts; whereas, in the manufacture of aluminum bronze, one of the greatest difficulties is to insure a uniform mixture. Often a very difficulty fusible alloy of copper and aluminum is formed upon the surface of the already melted portion, and accompanied by superficial oxidation, thus obstinately refusing to alloy with the remainder. But in the case of the boron compound no such difficulties are met with, the alloy melting perfectly, and at a lower temperature than when employing pure aluminum. Boron, in fact, seems to have been little studied, but it is evidently not so serious an enemy to cope with as its halogen silicon, which, when present in minute percentages only, determines the total ruin of the bronze with which it alloys; in other words, it stands almost entirely opposite to other elements, entering into the formation and forming compounds with the more refractory metals with the greatest ease; for instance, borides of iron, manganese, nickel, cobalt, etc., may be readily formed by the reduction of their accompanying borates in the presence of carbon, while those of silver, copper, gold, etc., can only be formed by the introduction of elementary boron into the fused mass; borides of the alkali metals, and even calcium, barium, etc., have also been obtained, but boride of mercury still holds out.

Aluminum-Copper.—2.—a.—The second class of copper-aluminum alloys embraces the aluminum casting alloys most applicable for general purposes. When aluminum is alloyed with from 7 to 10% of copper a tough alloy is secured, the tensile strength of which will vary from 15,000 to 20,000 lb. per square inch. This alloy has proved itself especially adaptable to automobile work and to those castings submitted to severe shocks and stresses. Because of the nature of its constituents, an alloy of the above, or of similar composition, is not so liable to be "burnt" in the foundry as an alloy made up of more volatile constituents. The remainder of the range of copper-aluminum alloys, from 20% of copper up to over 85%, give crystalline and brittle grayish-white alloys of no use in the arts. After 80% of copper is reached the distinctly red color of the copper begins to show itself.

b.—Aluminum-Brass. — Aluminum-brass has an elastic limit of about 30,000 lb. per square inch; an ultimate strength of from 40,000 to 50,000 lb. per square inch; and an elongation to 3 to 10% in 8 in. Aluminum is used in brass in all proportions, from 1-10 of 1% to 10%. The best results are derived by introducing the aluminum, when possible, in the form of aluminized zinc (q. v.) This aluminized zinc is added in the same manner that the zinc is originally introduced into the copper, and in such proportions as will give the requisite amount of aluminum in the brass mixture. A 5% aluminized zinc is generally used when percentages of less than 1% of aluminum are required; and aluminized zinc of 10% is used when a greater percentage than 1% is required. The effect of aluminum in brass, added in this manner, in small quantities of less than 1%, is mainly to make the brass flow freely, and present a smooth surface, free from blowholes. When used in these quantities, from one-half to one-third more small patterns can be used on a gate than can be used without the presence of aluminum, for this amount of aluminum gives to the brass such additional fluidity as enables it to run more freely in the molds and for a greater distance; consequently more patterns can be used on a gate. In quantities of more than 1% the effect of the aluminum commences to be very perceptible, because it imparts to the brass additional strength; and this strength is increased directly as the percentage of aluminum is increased, up to about 10%; 1% of aluminum in brass is very extensively used for electrical purposes, inasmuch as it makes a brass casting free from pinholes, and of greater strength than otherwise can be secured from the same grade of brass. It therefore follows that by the use of a small percentage of aluminum in brass a cheaper grade of brass can be used to do the same work, which otherwise would demand a better grade of brass. It should be noted that the presence of aluminum in these alloys lowers the point at which they become fluid, and that they are fluid at lower temperatures than either gun metal or ordinary brass mixtures; therefore, the average brass founder is very liable to overheat them. Great care must be taken to prevent this.

Gold.

Prof. W. C. Roberts-Austen has discovered a beautiful alloy, composed of 78 parts of gold and 22 parts of aluminum, which has a rich purple color.

Indium.

No valuable alloys of these metals have as yet been discovered.

Iron.

Aluminum combines with iron in all proportions. Few of the alloys, however, have yet proved of value, except those of small percentages of aluminum with steel, cast iron and wrought iron.

Cast Iron.—In cast iron, from 1 to 2 lb. of aluminum per ton is put into the metal as it is being poured from the cupola or melting furnace. To soft gray No. 1 foundry iron it is doubtful if the metal does much good, except, perhaps, in the way of keeping the metal melted for a longer time; but where difficult castings are to be made, where much loss is occasioned by defective castings, or where the iron will not flow well, or give sound and strong castings, the aluminum certainly in many cases allows better work to be done, and stronger and sounder castings to be made, having a closer grain, and hence much easier tooled. The tendency of the aluminum is to change combined carbon to graphitic, and it lessens the tendency of the metal to chill. Aluminum in proportions of 2% and over materially decreases the shrinkage of cast iron.

Ferro-Aluminum.—This is the trade name given to alloys of from 5 to 10, or even 20% of aluminum, added to iron. These alloys vary in quality, occasioned by the grade of steel or iron used in making them.

Steel.—The amount of aluminum used is small, and, to give the best results, varies with the grade of steel, amount of occluded gases, temperature of molten metal, etc. Aluminum is usually added in proportions of from ⅛ to ¾ lb. to 1 ton of steel. The aluminum is added either to the metal in the ladle, or, in the case of steel castings, with more economy of aluminum, to the metal as it is being poured into the ingot molds.

Until the proper percentage of aluminum to add to any particular grade of steel has been determined, it is advisable to start with small amounts; for instance, with 2 or 3 oz. to the ton, working up to the proportion that seems to give the best results.

The special advantages to be gained by the use of aluminum in steel manufacture are enumerated as follows: (1) The increase of soundness of tops of ingots, and consequent decrease of scrap and other loss. (2) The quieting of the ebullition in molten steel, thereby allowing the successful pouring of "wild" heats from furnaces, ladles, etc. (3) the prevention of oxidation, thus increasing the homogeneity of the steel. (4) The increase of tensile strength of steel without decrease of the ductility. (5) The removal of any oxygen or oxides that there may be in the steel, the aluminum acting as a deodorizer in the same way as manganese does. Good steel has been made for electrical purposes, using aluminum entirely in the place of manganese, to remove the oxidation from the molten steel and render it malleable. (6) The rendering of steel less liable to oxidation, because there is prevented the continued exposure of fresh surfaces of the molten steel in its ebullition in the molds after pouring. (7) The production of smoother surfaced castings and ingots of steel than it is possible to obtain without the use of aluminum.

There are no such metals as "aluminum steels," in the same way that there are "nickel steels" and "chromium steels." Aluminum is not a hardener of steel, and none of its alloys with steel has so far proved advantageous. It has been proved that the addition of aluminum to steel just before "teeming" causes the metal to lie quiet, and give off no appreciable quantity of gases, producing ingots with much sounder tops. There are two theories to account for this: one, that the aluminum decomposes these gases, and absorbs the oxygen contained in them; the other, is that aluminum greatly increases the solubility in the steel of the gases which are usually given off at the moment of setting, thus forming blowholes and bubbles.

Aluminum is the principal deoxidizer known to metallurgists, the next being silicon. Their relative values are shown as follows: 100 parts, by weight, of oxygen will combine with 114 parts of aluminum, or with 140 parts of silicon, or with 350 parts of manganese. This, however, does not correctly express the value of aluminum as a deoxidizer of iron and steel, inasmuch as it has such a great affinity for oxygen that it will entirely disappear if there is any oxygen present, and will be found in the steel and iron only after all the oxygen has been absorbed. This is not the case with either silicon or manganese.

There is danger of adding too large a quantity of aluminum, in which case the metal will set very solid, and will be liable to form deep "pipes" in the ingots. But successful results have been secured with varying kinds of steel by adding from ⅛ to ¾ lb. of aluminum to 1 ton of steel. No difficulty has been experienced with the thorough mixing of the aluminum added to steel, as it seems to rapidly and uniformly permeate the steel without any special care being taken in stirring. This property adds to the homogeneous alloying of nickel with steel as well, and the nickel-steel manufacturers use aluminum in addition to nickel for this purpose. If the metal be "wild" in the ladle, full of occluded gases, too hot, or oxidized, a larger proportion of aluminum can be advantageously added. In casting steel ingots which are to be hammered or rolled, it has been found advisable to add from 2 to 4 oz. of aluminum to 1 ton of steel. In the manufacture of steel castings, where the first desideratum is soundness of the castings and freedom from blowholes, and where the excessive piping and contraction in cooling is provided for by large runners and a high and capacious fountain or "sinking head," larger amounts of aluminum, up to 16, or even 32 oz. of aluminum to 1 ton of steel, are advantageously added.

An alloy of aluminum and ferro-manganese has been patented. The addition of a small percentage of aluminum to the ferro-manganese renders the combined carbon in the manganese alloy graphitic, and throws it out of the molten mass. This permits the production of a ferromanganese very low in combined carbon, and particularly useful in the manufacture of low-carbon steel.

Aside from the reduction of blowholes, and consequent greater soundness, the addition of about 1 lb. of aluminum per ton of steel is of advantage where the steel is to be cast in heavy ingots which will receive only scant work. Here it seems to increase the ductility, as measured by the elongation and reduction of area of tensile test specimens, without materially altering the ultimate strength. The additions of aluminum are, in many instances, made by throwing the metal into the ladle in pieces weighing a few ounces each, as the steel is poured into it. But some manufacturers prefer to add the aluminum in the form of ferro-aluminum; in this case the alloy is first placed in the ladle, and, as the molten steel runs in, the alloy melts, and is diffused through the entire contents of the ladle.

Wrought Iron.—The effect of aluminum in wrought iron is not very marked in the ordinary puddling process. It seems to add somewhat to the strength of the iron, but the amount is not of sufficient value to induce the general use of aluminum for this purpose. The peculiar property of aluminum in reducing the long range of temperature between that at which wrought iron first softens and that at which it becomes fluid, is taken advantage of in the well-known Mitis process for making "wrought-iron castings." It is for this that aluminum is most used in wrought iron at present. One per cent. of aluminum makes wrought iron more fluid at 2000°F. (which is about the melting point of cast iron) than it would be without it at 3500°F. In puddling iron an addition of 0.25% to the bath causes the charge to stiffen more quickly, and in the shingling process and in rolling the balls, to work much stiffer than usual. In one instance, where the ordinary iron averaged 22 tons tensile strength, with 12% elongation, the iron treated with aluminum showed over 30 tons tensile strength, with 22% elongation.

Lead.

These metals unite only with great difficulty, and no useful alloys have yet been discovered.

Magnesium.

The alloys of these light metals are interesting, because they are lighter than aluminum, and are equally as strong as the copper alloys of aluminum. On account of the cost of magnesium, they have not been widely adopted for commercial purposes.

Manganese.

Manganese is one of the best hardeners of aluminum.

Mercury.

These metals unite with difficulty, but at the same time amalgams and alloys can be produced by uniting the two metals. No useful results, however, have yet been shown from any of such alloys or combinations.

Metalloids.

Although all the metalloids and gaseous elements, such as oxygen, nitrogen, sulphur, selenium, chlorine, iodine, bromine, fluorine, boron, silicon and carbon unite with aluminum with more or less ease under certain conditions, yet no useful result has been recorded as due to the combination of any of these elements with metallic aluminum. The union of the above metalloids in combination with aluminum results in alloys which, from a commercial standpoint, are undesirable in every way. The prevention of the occlusion of gaseous metalloids in molten aluminum, and the prevention of the union of carbon with the metal, are among the chief precautions to be observed in the metallurgy of aluminum.

Molybdenum.

Aluminum can be readily alloyed with molybdenum in the process, by placing the molybdenum oxide in the electrolytic bath with the oxide of aluminum. Molybdenum acts as a hardener for aluminum, and forms alloys which will have special advantages for some work, as in the production of aluminum coins and medals.

Nickel.

1.—This alloy, with from 2 to 5% of the combined alloying metals, is very satisfactory for rolling or hammering. By larger proportions, of 7 to 9%, a good casting alloy is produced.

2.—Two new alloys for jewelry consist of: (1) Nickel, 20 parts; with aluminum 8 parts. (2) Nickel, 40 parts; silver, 10 parts; aluminum, 30 parts; tin, 20 parts.

Silver.

1.—The addition of a few per cent. of silver to aluminum, to harden, whiten and strengthen the metal, gives a material especially adaptable for many fine instruments and tools, and for electrical apparatus, where the work upon the tool, and its convenience, are of more consequence than the increased price due to the addition of the silver. Silver lowers the melting point of aluminum and gives a metal susceptible of taking a good polish and making fine castings.

2.—Aluminum, 3 parts; silver, 1 part. This alloy is very easy to work.

Tellurium.

When tellurium is heated with aluminum, the two combine with explosive violence, forming a chocolate-colored, difficulty fusible compound, which has the composition of $Al_2 Te_3$. It is hard and brittle, and can readily be ground to powder; when exposed to moist air it is decomposed, and hydrogen telluride, with its fetid odor, is slowly evolved; when thrown into water it is rapidly decomposed.

Tin.

1.—Tin has been alloyed with aluminum in proportions of from 1 to 15% of tin, giving added strength and rigidity to heavy castings, as well as sharpness of outline, with a decrease in the shrinkage of the metal. The alloys of aluminum and tin are rather brittle, however, and although small proportions of tin, in certain casting alloys, have been advantageously used to decrease the shrinkage, on account of the comparative cost and brittleness of the tin alloys, they are not generally used.

2.—Aluminum, 100 parts; tin, 10 parts.

3.—Aluminum, 90%; tin, 10%.

4.—*Bourbonne's Aluminum Alloy*—Aluminum and tin, equal parts. This alloy solders easily.

Titanium.

Titanium alloys of aluminum, although hard to manufacture uniformly homogeneous, have greater spring and resilience than most other aluminum alloys. Alloys of titanium, chromium and copper, together with aluminum, give some of the hardest and toughest light alloys yet produced.

Tungsten.

The alloys of aluminum and tungsten have been used to some extent for the past few years in Europe for rolled sheets and plates, under the trade name of "Wolframium."

Uranium.

This alloy is an expensive one; and while uranium appears to be a good hardener for aluminum, on account of its expense and rarity it has not had, as yet, a general application.

Vanadium.

Vanadium is a good hardener of aluminum, and can readily be alloyed with it, due to its presence in some of the bauxites, the native aluminum ores.

Zimalium.

The name of a new alloy of aluminum, magnesium and zinc. The specific weight is 2.65 to 2.75; in casting, 2.68 as against 2.64 for aluminum. It is harder, and more suitable to be worked. A softer variety serves for rolling, stamping, etc.; a harder one for casting. The tensile strength is double that of aluminum, 25 to 35 kg. per millimeter; the wires bear 30 to 37 kg.; the ductility rises up to 10%. Wires and sheet metal behave like brass. The castings can be filed, forged, cut, planed, etc., possess a tensile strength of 14 to 20 kg., and, upon rapid cooling, 20 to 25 kg. Zimalium is less resistive to chemical actions than aluminum. The electric conductivity amounts to two-thirds of that of the latter. The alloy is 10 to 12% dearer than aluminum.

Zinc.

Like copper alloys, the zinc alloys can be divided into two classes: (1) Those containing a relatively small amount of aluminum. (2) Those containing less than 35% of zinc. The first class will be treated under *Aluminized Zinc;* the second class comprises the useful zinc casting alloys. Zinc produces the strongest alloys with aluminum, the strength being still further increased by the addition of small amounts of other suitable metals. The tensile strength of the strongest of the zinc alloys frequently runs as high as 30,000 to 35,000 lb. per square inch. These high zinc alloys are brittle, however, and are more liable to "draw" in heavy parts or lugs than are the copper alloys. This can, in most cases, be overcome by suitable gating, placing of chills and risers. Zinc alloys also possess the danger of having the zinc burned out in melting, thus producing a weaker casting. With careful work, however, this class of alloys gives as good satisfaction as copper alloys in respect to hardness, ease of machining, and use in small parts not subject to severe shock. For forging, few metals excel an aluminum-zinc alloy containing from 10 to 15% of zinc. This alloy is tough, flows well under the forging dies, and produces a finished product that is solid, easily machined, and remarkably strong per unit of area.

Zinc is used as a cheap and very efficient hardener in aluminum castings, for such purposes as sewing-machine frames, etc. Proportions up to 30% of zinc with aluminum are successfully used. An alloy of about 15% of zinc, 2% of tin, 2% of copper, ½% each of manganese and iron, and 80% aluminum, has special advantages. The following alloys are strong, and meet all usual requirements:

	Al.	Zn.	Cu.	Sn.
For wire or sheet	28	5	..	..
For tubes	13	6	8	2
With good close grain	20	10	..	..
With good open grain	18	6	..	..

Aluminized Zinc.—Aluminized zinc is used for two purposes, namely: in the bath, for galvanizing, and in aluminum brass. It is manufactured as follows: Place 5 or 10 lb. of aluminum in a plumbago crucible. The amount used will depend upon whether a 5 or a 10% aluminum alloy is desired. After the aluminum is melted add the zinc, continually stirring the mass, until either 95 or 90 lb. of zinc have been added, making the total weight of the metal in the crucible, in either case, 100 lb. After all the zinc has been added the crucible should be removed from the fire, and the alloy cast into ingots of convenient form and size for breaking up. The 5% aluminized zinc will be found best for use in the galvanizing bath, and also in the lower grades of aluminum brass; but in the higher grades of brass, containing upward of 1% of aluminum, it would be best to use a 10% aluminized zinc. The aluminized zinc, both in brass and in the galvanizing baths, is treated, in all respects, the same as pure zinc, as far as the question of introducing it into molten metal is concerned.

Galvanizing Baths.—The use of aluminum in a galvanizing bath has become so universal that at the present time it is considered a necessity in order to do the best and most economical work. It is added in the form of aluminized zinc, which is made as described above, and is used in such proportions that the total amount of aluminum in the bath will be about 1 lb. of aluminum per ton of bath; or, in using a 5% aluminized zinc, 20 lb. of aluminized zinc per ton of bath should be used. These proportions, however, are varied according to the grade of zinc which is being used, and also according to the class of material to be galvanized. When aluminized zinc is used, it has been found unnecessary to use sal ammoniac for clearing the bath of oxide, inasmuch as the aluminum accomplishes the same purpose; and if the two are used together they seem to counteract the effects of each other. Aluminized zinc should be added to the galvanizing baths gradually as the bath is consumed, in quantities of about 1 lb. at a time for a 5-ton bath. This statement applies when a 5% aluminized zinc is used. The first action of aluminum in galvanizing baths is to make the bath more liquid, which is one of the objects in adding the aluminum. A great amount of aluminum seems to combine with the impurities in the zinc, and comes to the surface in the form of a scum, which makes galvanizing difficult. If, therefore, too much aluminum goes into the bath, stir the bath well, and allow it to stand for a while until the aluminum combines with these impurities and comes to the surface as a scum. Remove this scum, add some sal ammoniac to counteract the effects of the aluminum, and reduce the proportion of the aluminized zinc added. In starting with a new bath, it is especially important that these suggestions should be followed.

BISMUTH AND CADMIUM ALLOYS

Bismuth Bronze.

1.—A metallic alloy, which the inventor calls bismuth bronze, was introduced by Webster, as specially suitable for use in sea water, for telegraph and music wires, and for domestic articles. The composition varies slightly with the purpose for which the bronze is to be used, but in all cases the proportion of bismuth is very small. For a hard alloy he takes 1 part of bismuth and 16 parts of tin, and, having melted them, mixes them thoroughly as a separate or preliminary alloy. For a hard bismuth bronze he then takes 69 parts of copper, 21 parts of spelter, 9 parts of nickel, and 1 part of the bismuth-tin alloy. The metals are melted in a furnace or crucible, thoroughly mixed, and run into molds for further use. This bronze is hard, tough, and sonorous; it may be used in the manufacture of screw-propeller blades, shafts, tubes, and other appliances employed partially or constantly in sea water, being especially suited to withstand the destructive action of salt water. In consequence of its toughness it is well suited for telegraph wires and other purposes where much strain has to be borne.

From the sonorous quality it is well adapted for piano and other music wires. For domestic utensils, and other articles generally exposed to atmospheric influence, the composition is 1 part of bismuth, 1 part of aluminum, and 15 parts of tin, melted together to form the separate or preliminary alloy, which is added in the proportion of 1% to the above described alloy of copper, spelter and nickel. The resulting bronze forms a durable, bright and hard alloy, suited for the manufacture of spoons, forks, knives, dish covers, kettles, teapots, jugs, and numerous other utensils. These alloys are said to resist oxidation, to polish well and easily, and to keep their color well.

	I.	II.	III.	IV.
Copper	25	45	69	47
Nickel	24	32.5	10	30.9
Antimony	50	.	.	..
Bismuth	1	1	1	0.1
Tin	..	16	15	1
Zinc	..	21.5	20	21
Aluminum	..	..	1	..

I is hard and very lustrous, suitable for lamp reflectors and axle bearings. II is hard, resonant, and not affected by sea water, for parts of ships, pipes, telegraph wires and piano strings; III and IV are for cups, spoons, etc.

3.—Tin, 16 parts; bismuth, 1 to 3 parts.

Fusible Alloys.

Under the name, fusible metal, or fusible alloy, is understood a mixture of metals which becomes liquid at temperatures at or below he boiling point of water.

1.—*D'Arcet's.*—Bismuth, 8 parts; lead, 5 parts; tin, 3 parts. This melts below 212°F.

2.—*Walker's.*—Bismuth, 8 parts; tin, 4 parts; lead, 5 parts; antimony, 1 part. The metals should be repeatedly melted and poured into drops until they can be well mixed, previous to fusing them together.

3.—*Onion's.*—Lead, 3 parts; tin, 2 parts; bismuth, 5 parts. Melts at 197°F.

4.—If to the latter, after removing it from the fire, 1 part of warm quicksilver be added, it will remain liquid at 170°F., and become a firm solid only at 140°F.

5.—Bismuth, 2 parts; lead, 5 parts; tin, 3 parts. Melts in boiling water.

Nos. 1, 2, 3 and 5 are used to make toy spoons to surprise children by their melting in hot liquors. A little mercury (as in 4) may be added to lower their melting points. Nos. 1 and 2 are specially adapted for making electrotype molds. French *cliche* molds are made with the alloy No. 2. These alloys are also used to form pencils for writing, also as *metal baths* in the laboratory, or for soft-soldering joints. No. 4 is also used for anatomical injections.

Higher temperatures, for *metal baths* in laboratories, may be obtained by the following mixtures: 1 part tin and 2 parts lead melt at 441.5°F.; 1 part tin and 1 part lead melt at 371.7°F.; 2 parts tin and 1 part lead melt at 340°F.; 63 parts tin and 37 parts lead melt at 344.7°F.

Table of Fusible Alloys

Bismuth	Lead	Tin	Degrees F.	Bismuth	Lead	Tin	Degrees F.
8	5	3	202	8	16	24	316
8	6	3	208	8	18	24	312
8	8	3	226	8	20	24	310
8	8	4	236	8	22	24	308
8	8	6	243	8	24	24	310
8	8	8	254	8	26	24	320
8	10	8	266	8	28	24	330
8	12	8	270	8	30	24	342
8	16	8	300	8	32	24	352
8	16	16	304	8	32	28	332
8	16	12	290	8	32	30	328
8	16	14	290	8	32	32	320
8	16	16	292	8	32	30	328
8	16	18	298	8	32	36	320
8	16	20	304	8	32	38	322
8	16	22	312	8	32	40	324

Fusible Metals for Use in Boilers, etc.—The following alloys, with their corresponding melting points, together with the temperature of steam at various pressures, may be used:

Tin	Lead			Steam pressure by gauge.	Temp.
6	1		381°F.		
5	1		378°F.		
4	1		365°F.	120 lb.	350°F.
3	1		356°F.	105 lb.	341°F.
2	1		340°F.	90 lb.	331°F.
1½	1		334°F.	75 lb.	320°F.
4	4	Bismuth 1	320°F.	60 lb.	307°F.
3	3	„ 1	310°F.	45 lb.	282°F.
2	2	„ 1	292°F.	30 lb.	274°F.
1	1	„ 1	254°F.	15 lb.	250°F.
2	2	„ 1			292°F.
3	3	„ 1			310°F.
4	4	„ 1			320°F.
6	1				381°F.
5	1				378°F.
4	1				365°F.
3	1				356°F.
2	1				340°F.

Tin	Lead	Temp.
1½	1	334°F.
1	1	370°F.
1	2	441°F.
1	3	482°F.
1	5	511°F.
1	10	541°F.
1	25	558°F.

So much depends, however, on the way in which an alloy is made, the purity of its original metals, and the changing conditions to which a fusible plug is subjected, that it is very doubtful whether they should ever be depended upon in critical places.

Fusible Alloys and their Melting Points.—The following alloys will melt in boiling water or at a lower temperature:

	Tin.	Lead.	Bismuth.	Cadmium.	C.	F.
Newton's	3	2	5	0	100°	212°
Rose's...	3	8	8	0	95°	203°
Erman's.	1	1	2	0	93°	199°
Wood's..	2	4	7	1	70°	158°
Mellott's.	5	3	8	0	93°	200°
Harper's.	4	4	7	1	80°	180°

Erman's alloy can be made of equal parts of plumber's half-and-half solder (equal parts tin and lead) and bismuth. Harper's alloy can be made of 8 parts of plumber's half-and-half solder, 7 parts of bismuth and 1 part of cadmium, and can be poured into a modeling composition impression. It is hard enough to withstand the hammering required, and makes a smooth, sharp die.

Fusible Alloys Containing Cadmium.—Cadmium, like bismuth, has the valuable property of lowering the melting point of many alloys, some of which are readily fusible in boiling water. Cadmium does not render the alloys so crystalline and brittle as bismuth, many of its combinations being capable of being hammered and rolled. The chief use of cadmium is in fusible alloys, which are used as solders, for castings requiring a low temperature, and in dentistry for alloys for stopping hollow teeth. Alloys of cadmium generally contain tin, lead, bismuth, and cadmium. Mercury is sometimes added to still further lower the melting point.

The following table shows the composition and melting points of the more important cadmium alloys:

Alloys.	Cadmium.	Lead.	Tin.	Bismuth.	Melt'g point.
Lipowitz's..	3	8	4	15	158°F.
Fusible.....	2	11	3	16	170°F.
„	10	8	3	8	167°F.

Alloys	Cadmium.	Lead.	Tin.	Bismuth.	Melt'g point.
„	1	..	2	3	203°F.
„	1	..	3	5	203°F.
„	1	..	1	2	203°F.
„	1	2	1	4	150°F.
Wood's	2	4	2	5	160°F.
Fusible	2	2	4	..	187°F.
Type metal	22½	50	36	..	......

Cadmium alloy (melting point 170° F.): Cadmium, 2 parts; tin, 3 parts; lead, 11 parts; bismuth, 16 parts.

Cadmium alloy (melting point 167° F.): Cadmium, 10 parts; tin, 3 parts; lead, 8 parts; bismuth, 8 parts.

Cadmium alloys (melting point 203° F.):

	I.	II.	III.
Cadmium	1	1	1
Tin	2	3	1
Bismuth	3	5	2

A very fusible alloy, melting at 150° F., is composed of tin, 1 or 2 parts; lead, 2 or 3 parts; bismuth, 4 or 15 parts; cadmium, 1 or 2 parts.

Cadmium alloy (melting point 179.5° F.): Cadmium, 1 part; lead, 6 parts; bismuth, 7 parts. This can be used for soldering in hot water.

Cadmium alloy (melting point 300° F.): Cadmium, 2 parts; tin, 4 parts; lead, 2 parts. This is an excellent soft solder, with a melting point about 86° below that of lead and tin alone.

Bibra's Alloy.—Bismuth, 18 parts; tin, 9 parts; lead, 38 to 40 parts.

Casting.—1.—Bismuth Alloys for Delicate Castings.—For delicate castings, and for taking impressions from dies, medals, etc., various bismuth alloys are in use, whose composition corresponds to the following figures:

	I.	II.	III.	IV.
Bismuth	6	5	2	8
Tin	3	2	1	3
Lead	13	3	1	5

These alloys have the property, very favorable in making sharply outlined castings, that they expand strongly on cooling, and so fill out the finest elevations and depressions of the mold.

2.—Alloy for casting natural objects, such as fruits, leaves, beetles, snakes, lizards, etc.—Lipowitz metal: Tin, 4 parts; lead, 8 parts; bismuth, 15 parts; cadmium, 3 parts. This, the easiest melting metal mixture, softens at 55°C. (131° F.), and is completely fluid at 60°C. (140°F.). Wood's metal: Tin, 2 parts; lead, 4 parts; bismuth, 5 to 8 parts; cadmium, 1 to 2 parts. This silver-white looking, very fine grained alloy melts at 66°C and 72°C. It can also be used, with excellent results, for soldering.

3.—To make a cast with Lipowitz metal.—Plaster of paris is poured over the animal to be cast, and after sharp drying the animal is removed and the mold filled up with Lipowitz metal. The molt is placed in a vessel of water, and by heating to the boiling point the metal is melted and deposited in the finest impressions of the mold. This alloy is most excellent for soldering tin, lead, Britannia metal and nickel, being especially adapted to the two latter metals on account of its silver-white color; but its costliness prevents its general use, and cheaper alloys possessing the same properties have been sought.

4.—For small Articles.—This alloy melts at a low degree of temperature, and is very hard without being brittle. It consists of 6 parts of bismuth, 3 parts of zinc and 13 parts of lead. The three metals, after having been well melted and stirred together, should be poured into another melting-pot and melted again. This alloy cools with remarkably clear-cut edges, and if the articles made of it are dipped in dilute nitric acid, then rinsed in clear water, and polished with a woolen rag, the raised parts of the surface will have a fine polish, while the sunken parts will have a dark gray, antique appearance, which forms a pretty contrast. The proportions of the different metals, dividing the alloy into 100 parts, are: Bismuth, 27.27%; lead, 59.09%; zinc, 13.64%.

5.—For Small Castings.—Bismuth, 6 parts; tin, 3 parts; lead, 13 parts. This alloy should be melted, run into bars, and laid aside till wanted, when it should be remelted. An alloy of 3 parts of bismuth, 1 part of tin and 1 part of lead is harder, and yet it is not brittle. It can be finished with a contrasting surface of bright polish and dark gray, if it is washed in nitric acid, well diluted, rinsed, and polished with a woolen rag, as described in the alloy for small articles given above.

Cementing Glass, Bismuth Alloy for.—Most of the cements in ordinary use are dissolved, or at least softened, by petroleum. An alloy of lead, 3 parts; tin, 2 parts; bismuth, 2.5 parts, melting at 212° F., is not affected by petroleum, and is therefore useful for cementing lamps made of metal and glass combined.

Cliche Metal.—This alloy is composed of tin, 48 parts; lead, 32.5 parts; bismuth, 9 parts; antimony, 10.5 parts. It is especially well adapted to dabbing rollers for printing cotton goods, and as it possesses a considerable degree of hardness, it wears well. For filling out defective places in metallic castings, an alloy of 1 part of bismuth, 3 parts of antimony and 8 parts of lead can be advantageously used. An alloy consisting of 50 parts of lead, 36 parts of tin and 22.5 parts of cadmium is remarkably well adapted to the manufacture of *cliches*, or cuts, since with as low a melting point as the *cliche* metals generally used (made of bismuth alloys) it combines the valuable property of greater hardness. With a *cliche* or plate of this metal a large number of sharp impressions can be obtained.

Homberg's Alloy.—Bismuth, lead and tin, equal parts.

Krafft's Alloy.—Bismuth, 50 parts; lead, 20 parts; tin, 10 parts.

Newton's Metal consists of bismuth, 8 parts; lead, 5 parts; tin, 3 parts. It melts at 202°F.

Rose's Alloys consist of:

	I.	II.
Bismuth	2	8
Tin	1	3
Lead	1	8

The first of these alloys melts at 200.75° F., and the other at 174.2°F. They were formerly used in the manufacture of the so-called safety plates inserted in the tops of steam boilers. These plates were intentionally made of a readily fusible alloy, so that at a certain temperature, corresponding to a certain pressure in the interior of the boiler, they would become fluid, and allow the steam to escape through the opening thus made. They were to act as a sort of safety valve, to prevent the explosion of the boiler with too high a pressure of steam. But however correct the principle may appear, it was found in practice that the boilers would frequently explode without the plates having melted; and they are at the present tme hardly used at all. Chemical and physical tests have shown that by long-continued heating of the plates new alloys are formed whose melting points are much higher than those of the original compositions. The following table gives the compositions of some alloys which are said to melt if the pressure of the steam exceeds that indicated:

Bismuth.	Lead.	Tin.	Melting point, deg. F.	Corresponding pressure of steam in atmospheres.
8	5	3	212.0	1
8	8	4	235.9	1½
8	8	8	253.9	2
8	10	8	266.0	2½
8	12	8	270.3	3
8	16	14	289.5	3½
8	16	12	300.6	4
8	22	24	308.8	5
8	32	36	320.3	6
8	32	28	331.7	7
8	30	24	341.6	8

COPPER

Copper-Arsenic.

Arsenic imparts to copper a very fine white color, and makes it very hard and brittle. Before German silver was known these alloys were sometimes used for the manufacture of such cast articles as were not to come in contact with iron. When exposed to the air they soon lose their whiteness, and take on a brownish shade. On account of this, as well as the poisonous character of the arsenic, they are very little used at the present time. Alloys of copper and arsenic are best prepared by pressing firmly into a crucible a mixture of 70 parts of copper and 30 parts of arsenic (the copper to be used in the form of fine shavings) and fusing this mixture in a furnace with a good draft, under a cover of glass.

Blanched Copper.—Fuse 8 oz. of copper and ½ oz. of neutral arsenical salt with a flux made of calcined borax, charcoal dust and powdered glass.

Cobalt-Copper.

Metalline—The mixture known by the name of metalline has 25% of aluminum, 30% of copper, 10% of iron and 35% of cobalt. This alloy melts at a point approaching the melting point of copper, is tenacious, ductile, and very hard.

Copper-Iron.

The alloys of copper and iron are little used in the industries at the present day, but it would seem that in earlier times they were frequently prepared for the purpose of giving a considerable degree of hardness to copper; for in antique casts, consisting principally of copper, we regularly find quite large quantities of iron, which leads to the supposition that they were added intentionally. These alloys, when of a certain composition, have considerable strength and hardness. With an increase in the quantity of the iron the hardness increases, but the solidity is lessened. A copper and iron alloy of considerable strength, and at the same time very hard, is made of 66 parts of copper and 34 parts of iron. These alloys acquire, on exposure to air, an ugly color inclining toward black, and are, therefore, not adapted for articles of art.

Copper-Cobalt.

Sun-bronze.—The alloy called sun-bronze contains 10% of aluminum, 30 or 40% of copper, and 40% of cobalt. It melts at a point approaching the melting point of copper, is tenacious, ductile, and very hard.

Copper-Lead.

Cock Metal.—Copper, 20 lb.; lead, 8 lb.; litharge, 1 oz.; antimony, 3 oz.

Mira Metal, Acid-proof.—This alloy is characterized by its power of resisting the action of acids, and is, therefore, especially adapted to making cocks, pipes, etc., which are to come in contact with acid fluids. It is composed of copper, zinc, lead, tin, iron, nickel, cobalt and antimony, in the following proportions: Copper, 74.755; zinc, 0.615; lead, 16.350; tin, 0.910; iron, 0.430; nickel and cobalt, each 0.240; Antimony, 6.785.

Pot Metal.—This is an alloy of copper and lead, in the proportion of 8 parts of copper to 3 parts of lead. The lead is an impurity in the zinc used for making the brass. Pot metal is very brittle when warmed; it is chiefly used for making large vessels.

Lead.	Copper.	Description.
2 oz.	1 lb.	Red ductile alloy.
4 oz.	1 lb.	Red ductile alloy.
6 oz.	1 lb.	Dry pot metal or cock alloy.
7 oz.	1 lb.	Same, but shorter.
8 oz.	1 lb.	Wet pot metal.

Copper-Nickel.

Aphtite.—Iron, 66; nickel, 23; wolfram, 4; copper, 5.

Argasoid.—1.—Copper, 55.78; zinc, 23.198; nickel, 13.406; tin, 4.035; lead, 3.544. Silver white, almost ductile; suited for artistic purposes.

2.—A new alloy, called "argasoid," recently described by Mr. V. Jeuptner, of Vienna, has been used as a substitute for silver. Its cost is said to be about 50% more than brass. Its chemical composition is as follows: Tin, 4.035; lead, 3.544; copper, 55.780; nickel, 13.406; zinc, 23.198; iron, trace.

Argentan, White.—Zinc, 70 parts; copper, 15 parts; nickel, 6 parts.

Argiroide.—Variety of German silver. Usually plated.

Baudoin's Alloy.—Copper, 72%; nickel, 16.6%; cobalt, 1.8%; tin, 2.5%; zinc, 7.1%. About ½% of aluminum may also be added.

Birmingham Platinum.—Birmingham platinum, also called platinum-lead, is composed of copper and zinc, in proportions here given:

	I.	II.	III.
Copper	46.5	43	20
Zinc	53.5	57	80

It is of a pure, nearly silver-white color, which remains unchanged by the air for some time. Unfortunately, it is so brittle that it can hardly be shaped in any way except by casting. Buttons are made of it by casting in metal molds which give sharp impressions, and the design is afterward brought out more clearly by careful pressing.

Buttons, Metals for.—Guettier's:

	I	II.	III.
Brass (copper 297, zinc 93)	372	372	372
Zinc	62	47	140
Tin	31	47	...

Silver-colored metals of three qualities—best, medium and poor. Other alloys are: Birmingham platinum, copper 43, zinc 57; Forbes's metal, copper 46.5, zinc 53.5; Ludenscheid button metal, copper 20, zinc 80; bath metal, copper 18, zinc 21; Parsons's white metal, copper 55, zinc 45.

Chinese White Copper.—Copper, 40 parts; nickel, 32 parts; zinc, 25 parts; iron, 3 parts.

Clark's Patent Alloy.—Copper, 75%; nickel, 14.5%; zinc, 7.5%; tin, 1.5%; cobalt, 1.5%.

Electrum.—Nickel, 8 parts; copper, 16 parts; zinc, 7 parts.

Ferro-Argentan.—Copper, 70%; nickel, 20%; zinc, 5.5%; cadmium, 4.5%. Resembles silver; worked like German silver.

German Silver.—Albata, argentan, electrum, nickel silver, tutenag. Virginian plate, white copper. A well-known alloy, the finer varieties of which nearly equal silver in whiteness and susceptibility of receiving a high polish, while they surpass it in hardness and durability. The following formulae are from the highest authorities:

1.—Copper, 50 parts; nickel, 20 parts; zinc, 30 parts. Very malleable, and takes a high polish.

2.—Copper, 50 parts; nickel, 26 parts; zinc, 24 parts. Closely resembles silver; an excellent sample.

3.—Copper and zinc, of each 41 parts; nickel, 18 parts. Rather brittle.

4.—(M. Gersdorff.) Copper, 50 parts; nickel and zinc, of each 25 parts. Very white and malleable, and takes a high polish. Recommended as a general substitute for silver.

5.—(Gersdorff.) Copper, 60 parts; nickel and zinc, of each 20 parts. For castings, as bells, candlesticks, etc.

6.—(Gersdorff.) Copper, 60 parts; nickel, 25 parts; zinc, 20 parts. For rolling and wire. Very tough and malleable.

7.—(Sample made from the ore of Hillburghausen.) Copper, 40½ parts; nickel, 31½ parts; iron, 2½ parts; zinc, 25½ parts. Equal to the best Chinese sample.

8.—(Pelouze.). Copper and nickel, equal parts. Recommended by M. Pelouze as superior to any of the alloys containing zinc.

9.—(Pelouze.) Copper, 2 parts; nickel, 1 part. Not so white as the last, but more malleable.

10.—(White copper from China.) (1) Copper, 30 parts; nickel, 36 parts; zinc, 34 parts. (2) Said to be prepared from native ore: Copper, 41 parts; nickel, 32 parts; iron, 2½ parts; zinc, 24½ parts. Silvery white. takes a high polish, very sonorous, malleable both cold and at a dull-red heat, and may be rolled into leaves or formed into wire.

11.—(White metal spoon, sold as German plate.) Copper, 55 parts; nickel, 24 parts; zinc, 16 parts; tin, 3 parts; iron, 2 parts.

The union of the metals in the above formulae is effected by heat, with the usual precautions. When iron is ordered it is generally added under the form of "tin-plate."

12.—For fine German silver. Copper, 49 parts; zinc, 24 parts; nickel, 24 parts; aluminum, 2½ parts. All by weight. There are alloys of many other proportions that are recognized as standard.

13.—First quality for casting. Copper, 50 lb.; zinc, 25 lb.; nickel, 25 lb.

14.—Second quality for casting. Copper, 50 lb.; zinc, 20 lb.; nickel, best pulverized, 10 lb.

15.—For rolling. Copper, 60 lb.; zinc, 20 lb.; nickel, 25 lb. Used for spoons, forks and tableware.

16.—Frick's German Silver. Copper, 53.39 parts; nickel, 17.4 parts; zinc, 13 parts.

17. The composition of this alloy varies considerably, but from the adjoined figures an average may be found which will represent, approximately, the normal composition: Copper, 50 to 66 parts; zinc, 19 to 31 parts; nickel, 13 to 18 parts. The properties of the different kinds, such as their color, ductility, fusibility, etc., vary with the proportions of the single metals. For making spoons, forks, cups, candlesticks, etc., the most suitable proportions are 50 parts of copper, 25 parts of zinc and 25 parts of nickel. This metal has a beautiful blue-white color, and does not tarnish easily. German silver is sometimes so brittle that a spoon, if allowed to fall upon the floor, will break. This, of course, indicates faulty composition. As was said above, the composition varies so much, according to the mechanical manipulation to which the articles made from it are to be subjected, that it is impossible to give definite proportions. But the following table will show how the character of the alloy changes with the varying percentage of the metals composing it:

Argentan.	Copper.	Zinc.	Nickel.	Quality.
English . .	8	3.5	4	Finest quality.
English . .	8	3.5	6	Very beautiful, but very refractory.
English . .	8	6.5	3	Ordinary, readily fusible.
German .	52	26.0	22	First quality.
German .	59	30.0	11	Second quality.
German . .	63	31.0	6	Third quality.

18.—The following analyses give further particulars in regard to different kinds of argentan:

For sheet.	Copper,	Zinc.	Nickel.	Lead.	Iron.
French . .	50	31.3	18.7	. .	. .
French . . .	50	30	20	. .	. .
French . . .	58.3	25	16.7	. .	. .
Vienna . . .	50	25	25	. .	. .
Vienna . .	55.6	22	22	. .	. .
Vienna . .	60	20	20	. .	. .
Berlin	54	28	18	. .	. .
Berlin . . .	55.5	29.1	17.5	. .	. .
English. . .	63.34	17.01	19.13	. .	. .
English. . .	62.40	22.15	15.05	. .	. .
English. . .	62.63	26.05	10.85	. .	. .
English. . .	57.40	25	13	. .	3
Chinese .	26.3	36.8	36.8	. .	. .
Chinese .	43.8	40.6	15.6	. .	. .
Chinese . .	45.7	36.9	17 9	. .	. .
Chinese .	40.4	25.4	31.6	. .	2.60
Castings . .	48.5	24.3	24.3	2.9	. .
Castings . .	54.5	21.8	21.8	1.9	. .
Castings .	58.3	19.4	19.4	2.9	. .
Castings .	57.8	27.1	14.3	0.8	. .
Castings .	57	20	20	3	. .

In some kinds of argentan are found varying quantities of iron, manganese, tin, and, very frequently, lead, added for the purpose of changing the properties of the alloy or cheapening the cost of production; but all these metals have a detrimental rather than a beneficial effect upon the general character of the alloy, and especially lessen its power of resistance to the action of dilute acids, one of its most valuable properties. Lead makes it more fusible; tin acts somewhat as in bronze, making it denser and more resonant, and enabling it to take a higher polish. With iron or manganese the alloy is whiter, but it becomes at the same time more refractory, and its tendency toward brittleness is increased.

German Silver Substitute.—A substitute for German silver can be made by the use of manganese, the different metals and their proportions being as follows: Copper, 67.25%; zinc, 13%; manganese, 18.50%; luminum, 1.25%. The color of this metal is said to be very good, resembling German silver closely. It is fully as strong as the best German silver, and has superior casting qualities, which will be appreciated by foundrymen who have experienced some of the difficulties in casting German silver.

Lechesne—Copper, 1,200 parts; nickel, 800 parts; aluminum, 1 part. Melt the nickel first.

Lemarquand's Alloy.—This remarkable alloy is said to be non-oxidizable if all of the metals used are strictly pure. It is composed of 150 parts of copper, 28 parts of nickel, 4 parts of tin in sticks, 4 parts of black oxide of cobalt, and 14 to 15 parts of zinc.

Lutecine, or Paris Metal.—MM. Le Mat, Picard and Bloch give the following proportions for this alloy: Copper, 800 parts; nickel, 160 parts; tin, 20 parts; cobalt, 10 parts; iron, 5 parts; zinc, 5 parts; total, 1,000 parts.

Manganese Argentan.—Copper, 52 to 50 parts; nickel, 17 to 15 parts; zinc, 5 to 10 parts; manganese, 1 to 5 parts; phosphorus; copper with 15% phosphorus, 3 to 5 parts. Readily cast for objects of art.

Maillechort.—Copper, 60%; zinc, 20%; nickel, 20%; Jemmapes brass—copper, 64.5%.

Minargent.—This alloy, which is of a beautiful white color, contains no silver, but is made of copper, tungsten, aluminum and nickel, in the proportions of 1,000 parts of copper, 700 parts of nickel, 50 parts of tungsten, and 10 parts of aluminum.

Minofor.—Minofor is composed of copper, tin antimony, zinc and iron, in the following proportions:

	I.	II.
Copper	3.26	4
Tin	67.53	66
Antimony	17.00	20
Zinc	8.94	9
Iron	....	1

Both these alloys are sometimes used in England for purposes where the ordinary Britannia metal, 2 parts tin and 1 part antimony, might equally well be employed. The latter surpasses both of them in beauty of color, but they are, on the other hand, harder.

Mosaic Silver, Production and Application of.—Same consists of tin, 3 parts by weight, bismuth 3 parts, and mercury 1½ parts. The alloy of these metals is powdered finely, thus forming a silvery mass, used for imitation silvering of metals, paper, wood, etc. In order to impart to metals, especially articles of copper and brass, an appearance similar to silver, they are made perfectly bright; the powder of the mosaic silver is mixed with 6 times the volume of bone ashes, adding enough water to cause a paste, and rubbing the same on the metallic surface by means of a cork of suitable shape. In order to silver paper by means of this preparation, it is ground with white of egg, diluted mucilage or varnish, and treated like a paint.

Nickel Bronze.—This is prepared by fusing together very highly purified nickel (99.5%) with copper, tin and zinc. A bronze is produced containing 20% of nickel, light-colored, and very hard.

Non-Magnetic Alloy for Watch Springs.—Composed of tin, copper, iron, lead, zinc, nickel and manganese. The proportions vary, but 60% of copper, 20% of nickel, and 18% of zinc, with the other ingredients 1% or less.

Packfong—1.—Copper, 40 parts; zinc, 25 parts; nickel, 31 parts.

2.—Copper, 43 parts; zinc, 40 parts; nickel, 16 parts.

3.—Copper, 45 parts; zinc, 21 parts; nickel, 33 parts.

Parisian Alloy.—Copper, 69%; nickel, 19.5%; zinc, 6.5%; cadmium, 5%.

Platine.—Platine is a brass, made of 80 parts of brass and 20 parts of copper; is white, and used especially for buttons.

Platinoid.—An alloy of 60 parts of copper, 14 parts of nickel and 24 parts of zinc, to which 1 to 2% of tungsten is added, is largely used in electrical work, on account of its high resistance.

Tonca's Metal.—Copper, 5 parts; nickel, 4 parts; tin, 1 part; lead, 1 part; iron, 1 part; zinc, 1 part; antimony, 1 part. It is hard, difficult to fuse, not very ductile, and cannot be recommended.

Copper-Phosphor.

Phosphor copper may be prepared in a variety of ways: (1) By dropping phosphorus upon molten copper in a crucible, an alloy rich in phosphorus is obtained, forming an extremely hard steel-gray fusible compound. (2) by reducing phosphate of copper with charcoal, or charcoal and carbonate of soda. (3) by heating a mixture of 4 parts of bone ash, 1 part of charcoal and 2 parts of granulated copper at a moderate temperature. The melted phosphide of copper separates on the bottom of the crucible, and is stated to contain 14% of phosphorus. (4) By adding phosphorus to copper-sulphate solution and boiling. The precipitate is dried, melted, and cast into ingots. When of good quality, and in proper condition, it is quite black. (5) Copper phosphide is easily prepared by adding to a crucible 14 parts of sand, 18 parts of bone ash, 4 parts of powdered coal, 4 parts of sodium carbonate, and 4 parts of powdered glass; the whole being intimately mixed with 9 parts of granulated copper. A lid is then luted on and the crucible exposed to a strong heat. The sand acts on the bone ash, forming silicate of lime. The liberated phosphoric acid is reduced by the coal, and the phosphorus thus set free unites with the copper. (6) Montefiori-Levi and Kunzel prepare phosphor copper by putting sticks of phosphorus into crucibles containing molten copper. To avoid a too ready combustion the sticks of phosphorus are previously coated with a firm layer of copper, by placing them in a solution of copper sulphate. (7) By strongly heating in a crucible an intimate mixture of bone ash, copper oxide and charcoal, phosphor copper is produced.

Copper-Tin.

Bell Metal.—1.—The various alloys used in the manufacture of bells consist essentially of copper and tin, but in some cases other metals are added in small quantities, either for cheapness or to produce a desired quality of sound. The additional metals chiefly used are zinc, lead, iron, and sometimes bismuth, silver, antimony and manganese. The following are some of the proportions employed: Musical bells, 84% copper, 16% tin. Sleigh bells, 84.5% copper, 15.4% tin, 0.1% antimony. Gongs, 82% copper, 18% tin. House bells, 80% copper, 20% tin. House bells, 78% copper, 22% tin. Large bells, 76% copper, 24% tin. Swiss clock bells, 74.5% copper, 25% tin, 0.5% lead. Old bell at Rouen, 71% copper, 26% tin, 1.8% zinc, 1.2% lead. Clock bells, 72% copper, 26.56% tin, 1.44% silver. Alarm bell at Rouen, 75.1% copper, 22.3% tin, 1% zinc, 1.6% silver, Tam-tam, 79% copper, 20.3% tin, 0.52% lead, 0.18% silver. Japanese kara kane, 64% copper, 24% tin, 9% zinc, 3% iron. Japanese kara kane, 70% copper, 19% tin, 3% zinc, 8% lead. Japanese kara kane, 61% copper, 18% tin, 6% zinc, 12% lead, 3% iron. White table bells, 17% copper, 80% tin, 3% bismuth. White table bells, 87.5% tin, 12.5% antimony. Small bells, 40% copper, 60% tin.

2.—The composition of bell metal can be varied considerably, and the tone of the bell varies accordingly, as may be seen from the following: Normal composition, 80% copper, 20% tin. Normal composition, 78% copper, 22% tin. Rouen alarm bell, 76.1% copper, 22.3% tin, 1.6% zinc, 1.6% silver. Ziegenhain alarm bell, 71.48% copper, 33.59% tin, 4.04% lead, 0.12% iron. Darmstadt alarm bell, 73.94% copper, 21.67% tin, 1.19% lead, 0.17% silver. Reichenhall alarm bell (13th century), 80% copper, 20% tin, Tam-tam, 78.51% copper, 10.27% tin, 0.52% lead, 0.18% silver. Japanese bells, 1.10% copper, 4% tin, 1.5% zinc. 0.5% silver. Japanese bells, 2.10% copper, 2.5% tin. 0.5% zinc, 1.33% lead. Japanese bells, 3.10% copper, 3% tin, 1% zinc, 2% lead, 0.5% silver. Japanese bells, 4.10% copper. Small clock bells, table bells, sleigh bells, etc., require an alloy which will give a clear and pure tone. It has been learned by experience that bell metal containing about 22% of tin gives the highest tone, and is, therefore, suited to small bells. It is an object, however, in this case, to produce the alloy as cheaply as possible by reducing the proportion of the copper, its most expensive component. The following will show the composition of the alloys used for small bells: (1) House bells, 80% copper, 20% tin. (2) House bells, smaller, 75% copper, 25% tin. (3) German clock bells, 73% copper, 24.3% tin, 2.7% zinc. (4) Swiss clock bells, 74.5% copper, 25% tin, 0.5% lead. (5) Paris clock bells, 72% copper, 26.56% tin, 1.44% silver. (6) Sleigh bells, 84.5% copper, 15.42% tin, 0.1% silver. The alloy numbered (6) contains, in addition, 0.1% of antimony.

3.—Melt together, under powdered charcoal, 100 parts of pure copper with 20 parts of tin, and unite the two metals by frequently stirring the mass. Product very fine.

4.—Copper, 3 parts; tin, 1 part, as above. Some of the finest church bells in the world have this composition.

5.—Copper, 72 parts; tin, 26½ parts; iron, 1½ parts. The bells of small clocks or pendules are made of this alloy in Paris.

6. Bell Metal, Fine.—Copper, 71 parts; tin, 26 parts; zinc, 2 parts; iron, 1 part.

7.—Bell Metal, for Large Bells.—Copper, 100 lb.; tin, from 20 to 25 lb.

8.—Bell Metal, for Small Bells.—Copper, 3 lb.; tin, 1 lb.

9.—Alloys for Cymbals and Gongs.—Copper, 100 parts, with about 25 parts of tin. To give this compound the sonorous property in the highest degree, the piece should be ignited after it is cast, and then plunged immediately into cold water.

10.—Alloy for Tam-tams or Gongs.—Copper, 8 parts; tin, 20 parts; hammered out, with frequent annealing. An alloy of 78% of copper and 22% of tin answers better and can be rolled out.

11.—Kara Kane Bell Metal.—The Japanese, who are great bronze workers, add lead, zinc and iron to their bell metal, with wonderful effect. Their name for these compounds is kara kane. The following are the proportions they use: First quality, 60 parts copper, 24 parts tin, 9 parts zinc, 3 parts iron; second quality, 60 parts copper, 15 parts tin, 3 parts zinc, 8 parts lead; third quality, 60 parts copper, 18 parts tin, 6 parts zinc, 12 parts lead, 3 parts iron. For small bells they employ the first quality, and for large bells the third quality.

12.—Silver Bell Metal.—This alloy, used for small bells, has a very beautiful silvery tone, and is nearly white in color. It is made in three varieties: (1) Copper, 40%; tin, 60%. (2) Copper, 41.5%; tin, 58.5%. (3) Copper, 41.7%; tin, 58.4%. Large bells are cast in loam molds, the design or ornamentation of the bell being given by the shape of the mold, and perfected by chasing after it has cooled. Small bells are usually cast in sand molds, though at the present time iron molds are frequently employed.

13.—Algiers metal is also used for small hand bells. (See TIN ALLOYS.)

Bronze.—1.—The term "bronze" is usually applied to all alloys consisting chiefly of copper and tin. These metals have been known from very remote times, and the importance of the mixture of copper and tin appears to have been among the first discoveries of the metallurgists. It is remarkable for the exactness of the impressions which it takes by molding, as well as its durability; hence, extensively employed in the casting of busts, medals and statues. Bell, cannon, and speculum metal are varieties of bronze. In ancient times, when the manufacture of steel was ill understood, cutting instruments were frequently made of this alloy. For statuary work the great desideratum is to obtain an alloy capable of flowing freely into the most minute outlines of the mold, hard, and yet tough, and capable of resisting the corroding action of the weather. It must also acquire that peculiar antique green appearance that is so much admired in bronzes. When only a small quantity of the alloy is required it is prepared in crucibles, but for statues or larger works, on reverberatory hearths. The fusion of the mixed metals must be conducted under pounded charcoal, and as rapidly as possible. When melted it must be frequently stirred together, to produce a perfect mixture, before casting. Coal is the fuel principally employed for the furnaces. The great feature of modern bronzes is the substitution of triple and quadruple alloys for the old dual alloys. French bronzes nearly always contain the four metals, copper, tin, lead and zinc, and in some cases small quantities of nickel, arsenic, antimony and sulphur. Each of these elements exerts an influence on bronze in proportion to the amount present, and if such influence is prejudicial for certain uses care must be taken in the selection of the metals employed for admixture. Impure copper is by no means a rarity in commerce, and may contain ingredients fatal to the properties of certain varieties of bronze. The difficulty of preparing alloys of definite composition is increased when scrap is remelted with new metal, unless great care is taken to keep scrap of a given quality separate from other varieties; such old metal is also liable to contain iron and other foreign metals mechanically mixed with it. Zinc, in small quantity, added to copper and tin, often has a beneficial influence, as in casting, for instance, the metal runs thinner, fills upon the molds, and is freer from pinholes. Lead alloys very imperfectly with bronze, showing a great tendency to liquate out on cooling, the greater portion being found in the lower part of the casting. A small quantity of lead is said to make the alloy more malleable and denser. The peculiar patina of a velvety black color found on old Chinese bronzes is probably due to the presence of lead. Iron, in certain amounts, affects the properties of bronze very beneficially. It hardens the alloy and increases its resistance to wear in cases where the bronze is subjected to considerable friction, as in machinery bearings. Such alloys are paler in color and more difficult to melt than with copper and tin alone. In small quantities, iron increases the tenacity of bronze. In 1858 Parker noticed that the addition of phosphorus during the melting together of copper and tin improved the physical propertties of bronze, and this addition was eventually introduced into bronze manufacture with very successful results. (See PHOSPHOR BRONZE.)

2.—Simple Bronzes.—Proportions and results. In the following table the first column of figures denotes copper, the second tin.

lb.	oz.	Color.	Description.
1	0.5	Reddish yellow.	Ancient nails.
1	1.0	Reddish yellow.	Soft gun bronze.
1	1.3	Reddish yellow.	For mathematical instruments.
1	1.5	Reddish yellow.	For toothed wheels.
1	2.0	Yellow red.	Ordnance.
1	2.3	Yellow red.	Hard weapon and tool bronze.
1	2.5	Yellow red.	Hard machinery bearing bronze.
1	3.0	Bluish red.	Soft, for musical bells.
1	3.5	Bluish red.	Soft, for gongs.
1	4.0	Ash gray.	Soft, for house bells.
1	4.5	Ash gray.	Soft, for larger bells.
1	5.0	Dark gray.	Soft, for the largest bells.
1	7.0	Whitish.	Ancient mirrors.
1	8.0	Whiter.	Speculum bronze.
1	32.0	Whiter still.	Pewterers' temper.

3.—Acid-resisting Bronze.—A new alloy has been prepared by Herr Reith, of Bockenheim, Germany, and is said to practically resist the attack of moist acid and alkaline solutions. It consists of copper, 74.5 parts; tin, 11.6 parts; lead, 9 parts; antimony, 4.9 parts. This alloy is therefore a bronze with the addition of lead and antimony. The inventor claims that it can be very advantageously used in the laboratory to replace vessels or fittings of ebonite, vulcanite, or porcelain.

4.—Castings.—For the manufacture of certain articles, which are to be produced in large quantities, it is desirable to have a bronze which becomes very thinly fluid in heat, and fills out the molds well. It is customary to use cast-iron molds, and articles cast from this quality of bronze need only a slight surface chiseling to make them ready for commerce. A bronze which possesses the requisite properties in a high degree is composed of 94.12 parts of copper and 5.88 parts of tin.

5.—Fontainemoreau's Bronzes.

Zinc.	Copper.	Cast Iron.	Lead.
90	8	1	1
91	8	0	1
92	8	0	0
92	7	1	0
97	2½	½	0
97	3	0	0
99½	0	½	0
99	1	0	0

Gold Bronze. (See GOLD ALLOYS, GOLD SUBSTITUTES and IMITATION GOLD ALLOYS.)

6.—For Cutting Instruments.—Copper, 100 parts; tin, 14 parts.

7.—Japan Bronze.—The formulae that we give below contain a large percentage of lead, which greatly improves the patina. The ingredients and the ratio of their parts for three sorts of modern Japanese bronze, follow:

a.—Copper, 81.62%; tin, 4.61%; lead, 10.21%.

b.—Copper, 76.60%; tin, 4.38%; lead, 11.88%; zinc, 6.53%.

c.—Copper, 88.55%; tin, 2.42%; lead, 4.72%; zinc, 3.20%.

Sometimes a little antimony is added just before casting, and such a composition would be represented more nearly by this formula:

d.—Copper, 68.25%; tin, 5.47%; zinc, 8.88%; lead, 17.06%; antimony, 0.34%.

8.—For Medals.—(1) Copper, 89 parts; tin, 8 parts; zinc, 3 parts. (2) Copper, 95 parts; tin, 5 parts.

9.—Bronze Metal.—(1) Copper, 7 lb.; zinc, 3 lb.; tin, 2 lb. (2) Copper, 1 lb.; zinc, 12 lb.; tin, 8 lb.

10.—Bronze for Mortars.—Copper, 93 parts; lead, 5 parts; tin, 2 parts. The edges and lips of mortars must be tempered by heating them to a cherry red, and then plunging them into cold water; as unless so treated they are very apt to be broken.

11.—Rivet Metal.—(1) Copper, 32 oz.; tin, 2 oz.; zinc, 1 oz. (2) Copper, 64 lb.; tin, 1 lb.

12.—Bronze for Sheathing Ships.—On account of the superiority of bronze to pure copper in point of durability under the action of sea water, many attempts have been made in the past to substitute it for the latter in the sheathing of ships, but it was long before any satisfactory results were reached, since no method of rolling out bronze was known. It was finally discovered that an alloy of the nature of bronze, composed of 100 parts of copper and from 4.5 to 7 parts of tin, can easily be rolled into sheets at red heat, and at the present day such bronze sheets are frequently used instead of copper for the sheathing of wooden ships.

13.—Statuary Bronze.—a.—Many of the antique statues were made of genuine bronze, which has advantages for this purpose, but has been superseded in modern times by mixtures of metals containing besides copper and tin—the constituents of real bronze—a quantity of zinc, the alloy thus formed being really an intermediate product between bronze and brass. The reason for the use of such mixtures lies partly in the comparative cheapness of their production as compared with genuine bronze, and partly in the purpose for which the metal is to be used. A thoroughly good statuary bronze must become thinly fluid in fusing, fill the molds out sharply, allow of being easily worked with the file, and must take on the beautiful green coating called patina, after being exposed to the air for a short time. Genuine bronze, however strongly heated, does not become thin enough to fill out the molds well, and it is also difficult to obtain homogeneous castings from it. Brass alone is also too thickly fluid, and not hard enough for the required fine chiseling or chasing of the finished object. Alloys containing zinc and tin, in addition to copper, can be prepared in such a manner that they will become very thinly fluid, and will give fine castings which can easily be worked with the file and chisel. The best proportions seem to be from 10 to 18% of zinc and from 2 to 4% of tin. In point of hardness, statuary bronze holds an intermediate position between genuine bronze and brass, being harder and tougher than the latter, but not so much so as the former. Since statuary bronze is principally used for artistic purposes, much depends upon the color. This can be varied from pale yellow to orange yellow by slightly varying the content of tin or zinc, which must, of course, still be kept between the limits given above. Too much tin makes the alloy brittle and difficult to chisel; with too much zinc, on the other hand, the warm tone of color is lost, and the bronze does not acquire a fine patina. The best proportions for statuary bronze are very definitely known at the present day; yet it sometimes happens that large castings have not the right character. They are either defective in color, or they do not take on a fine patina, or they are difficult to chisel. These phenomena may be due to the use of impure metals—containing oxides, iron, lead, etc.—or to improper treatment of the alloy in melting. With the most careful work possible there is considerable loss in melting, 3% at the very least, and sometimes as much as 10%. This is due to the large proportion of zinc, and it is evident that in consequence of it the nature of the alloy will be different from what might be expected from the quantities of the metals used in its manufacture. It has been remarked that slight variations in composition quickly change the color of the alloy. The following tables gives a series of alloys of different colors, suitable for statuary bronze:

Copper.	Zinc.	Tin.	Color.
84.42	11.28	4.30	Reddish yellow
84.00	11.00	5.00	Orange red
83.05	13.03	3.92	Orange red
83.00	12.00	5.00	Orange red
81.05	15.32	3.63	Orange yellow
81.00	15.00	4.00	Orange yellow
78.09	18.47	3.44	Orange yellow
73.58	23.27	3.15	Orange yellow
73.00	23.00	4.00	Pale orange
70.36	26.88	2.76	Pale yellow
70.00	27.00	3.00	Pale yellow
65.95	31.56	2.49	Pale yellow

b.—Copper, 88 parts; tin, 9 parts; zinc, 2 parts; lead, 1 part.

c.—Copper, 88½ parts; tin, 5 parts; zinc, 10½ parts; lead, 2 parts.

d.—Copper, 90 parts; tin, 9 parts; lead, 1 part.

e.—Copper, 91 parts; tin, 9 parts.

File Alloys.—Owing to the great hardness which is peculiar to many copper-tin alloys, the latter are also employed for the making of files, which, in distinction from the steel files, are designated composition files. According to the *Metallarbeiter*, such alloys have the following composition:

Geneva Composition Files

	I.	II.
Copper	64.4	62
Tin	18.0	20
Zinc	10.0	10
Lead	7.6	8

Vogel's Composition Files

	I.	II.	III.
Copper	57.0	61.5	73.0
Tin	28.5	31.0	10.0
Zinc	78.0	...	8.0
Lead	7.0	8.5	8.0

Gun Metal.—1.

No.	Copper.	Tin.	Zinc.	Color.
I	92	2	6	Pale red.
II	90	8	2	Reddish yellow.
III	84	5	11	Yellow.
IV	83	5	12	Yellow.
V	80	5	5	Pale yellowish pink.
VI	80	5	15	Yellow.
VII	75	5	20	Greenish yellow.

No. I is tough, malleable and tenacious. No. II is hard, somewhat unyielding, and easily broken. Nos. III and IV work well under the file and chisel. No. V is hard, but somewhat malleable. No. VI is hard and resisting, tough, and works fairly well with the file and chisel. No. VII is hard, and easily broken, but may be filed. The alloys are hard and brittle when the copper is less than 66% of the mixture; and when the copper is reduced to 50% the alloys are extremely hard and brittle. The addition of a little lead improves the above alloys for turning and filing.

2.—A sample of so-called "gun-metal," stated by the user to be very strong and durable, and used for crown-wheel escapements, gave on analysis: Copper, 87.85%; zinc, 5.07%; tin, 4.96%; lead, 1.84%; iron, .28%; total, 100%.

3.—An alloy prepared by Mr. Stirling, and tried in the Arsenal of Woolwich, has a resistance to flexion much greater than that of ordinary bronze; it contains: Copper, 87%; tin, 8.7%; zinc, 4.3%; total, 100%.

4.—

	Copper.	Tin.	Iron.	Zinc.	Lead.
English ordnance	91.74	8.26	...	...	....
English ordnance	91.80	8.20	...	...	....
Eight-pounder guns	91.66	8.33	...	...	....
Prussian ordnance	90.91	9.09	...	...	....
French ordnance	90.73	9.27	...	...	....
French ordnance	90.09	9.90	...	...	....
Amer. compressed ordnance...	90.00	10.00	...	...	....
Amer. compressed ordnance...	90.27	9.73	...	...	....
Russian ordnance (1819)	88.61	10.70	0.69	...	....
Swiss ordnance..	88.93	10.38	0.11	0.42	0.06
Chinese ordnance	77.18	3.42	1.16	5.02	13.22
Chinese ordnance	93.19	5.43	1.38	...	....

Models, Alloy for Making.—A good alloy for making working models is 4 parts of copper, 1 part of tin and ¼ part of zinc. This is easily wrought. Doubling the proportion of zinc increases the hardness.

Phosphor Bronze.—The variety of bronze known by this name is not to be considered as an alloy containing a certain amount of copper, but rather as a bronze subjected to a peculiar treatment with the use of compounds of phosphorus. Many good phosphor bronzes contain but a very small quantity of phosphorus, which exerts no essential influence upon the character of the alloy. In these cases the phosphorus acted during the preparation of the alloy. Bronze not infrequently contains a considerable quantity of cuprous oxide in solution, which is formed by direct oxidation of the copper during fusion, and this admixture is highly detrimental to the strength of the alloy. If now the melted bronze be treated with a substance capable of exerting a powerful reducing action, as, for instance, phosphorus, a complete reduction of the cuprous oxide will take place, and the bronze will acquire a surprisingly high degree of strength and power of resistance. If precisely the quantity of phosphorus necessary for the complete reduction of the oxide has been used, no phosphorus will be found in the alloy, which nevertheless must be classed as phosphor bronze. It follows from what has been said that phosphor bronze is not a special kind of alloy, but that any bronze can be made into phosphor bronze; it is, in fact, simply a deoxidized bronze. Besides its action in reducing the oxides dissolved in the alloy, the phosphorus exerts another very material influence upon the properties of the bronze. The ordinary bronzes consist of mixtures in which the copper is really the only crystallized constituent, since the tin crystallizes with great difficulty. As a consequence of this dissimilarity in the nature of the two metals, the alloy is not as solid as it would be if both were crystallized. The phosphorus causes the tin to crystallize, and the result is a more homogeneous mixture of the two metals. If enough phosphorus is added so that its presence can be detected in the finished bronze, the latter may be considered an alloy of crystallized phosphor tin with copper. If the content of phosphorus is still more increased, a part of the copper combines with the phosphorus, and the bronze then contains, besides copper and tin, compounds of crystallized copper phosphide with phosphide of tin. The strength and tenacity of the bronze are not lessened by a larger amount of phosphorus, and its hardness is considerably increased. Many phosphor bronzes are equal in this respect to the best steel, and some even surpass it in general properties. The phosphorus is added to the bronze in the form of copper phosphide or phosphide of tin, the two being sometimes used together. They must be specially prepared for this purpose, and the best methods will be here given.

Copper phosphide is prepared by heating a mixture of 4 parts of superphosphate of lime, 2 parts of granulated copper and 1 part of finely pulverized coal in a crucible, at a temperature not too high. The melted copper phosphide, containing 14% of phosphorus, separates on the bottom of the crucible.

Tin phosphide is prepared as follows: Place a bar of zinc in an aqueous solution of tin chloride. The tin will be separated in the form of a spongelike mass. Collect it, and put it into a crucible upon the bottom of which sticks of phosphorus have been placed. Press the tin tightly into the crucible, and expose to a gentle heat. Continue the heating until flames of burning phosphorus are no longer observed on the crucible. The pure tin phosphide, in the form of a coarsely crystalline mass, tin-white in color, will be found on the bottom of the crucible.

To prepare the phosphor bronze the alloy to be treated is melted in the usual way, and small pieces of the copper phosphide and tin phosphide are added. Phosphor bronze, properly prepared, has nearly the same melting point as that of ordinary bronze. In cooling, however, it has the peculiarity of passing directly from the liquid into the solid state, without first becoming thickly fluid. In a melted state it retains a perfectly bright surface, while ordinary bronze in this condition is always covered with a thin film of oxide. If phosphor bronze is kept for a long time at the melting point there is not any loss of tin, but the amount of phosphorus is slightly diminished. The most valuable properties of phosphor bronze are its extraordinary tenacity and strength. It can be rolled, hammered, and stretched cold, and its strength is nearly double that of the best ordinary bronze. It is principally used in cases where great strength and power of resistance to outward influences are required, as, for instance, in objects which are to be exposed to the action of sea water. Phosphor bronze containing about 4% of tin is excellently well adapted for sheet bronze. With not more than 5% of tin it can be used, forged, for firearms; 7 to 10% of tin gives the greatest hardness, and such bronze is especially suited to the manufacture of axle bearings, cylinders for steam fire engines, cogwheels, and, in general, for parts of machines where great strength and hardness are required. Phosphor bronze, if exposed to the air, soon becomes covered with a beautiful, closely adhering patina, and is, therefore, well adapted to purposes of art. The amount of phosphorus added varies from 0.25 to 2.5%, according to the purpose of the bronze. The composition of a number of kinds of phosphor bronze is given below:

(1) Copper, 90.34%; tin, 8.90%; phosphorus, 0.76%. (2) Copper, 90.86%; tin, 8.56%; phosphorus, 0.196%. (3) Copper, 94.71%; tin, 4.39%; phosphorus, 0.053%.

(I) Copper, 85.55%; tin, 9.85%; zinc, 3.77%; lead, 0.62%; iron, traces; phosphorus, 0.05%. (II) Tin, 4 to 15%; lead, 4 to 15%; phosphorus, 0.5 to 3%. (III) Tin, 4 to 15%; zinc, 8 to 20%; lead, 4 to 15%; phosphorus, 0.25 to 2%. (IV) Copper, 77.85%; tin, 11%; zinc, 7.65%. (V) Copper, 72.50%; tin, 8%; zinc, 17%. (VI) Copper, 73.50%; tin, 6%; zinc, 19%. (VII) Copper, 74.50%; tin, 11%; zinc, 11%. (VIII) Copper, 83.50%; tin, 8%; zinc, 3%.

(I) for axle bearings, (II) and (III) for harder and softer axle bearings, (IV) to (VIII) for railroad purposes, (IV) especially for valves of locomotives, (V) and (VI) for axle bearings for wagons, (VII) for connecting rods, (VIII) for piston rods in hydraulic presses.

Among other properties, phosphor bronze emits sparks under friction much less readily than gun metal or copper, and oxidizes in sea water at about one-third the rate of copper.

1.—One of the principal uses of phosphor bronze is in the form of springs. A good mixture for phosphor bronze springs is as follows: Copper, by weight, 95 parts; tin, 4½ parts; 5% phosphor tin, ½ part.

2.—For phosphor bronze of the highest possible strength the following mixture is recommended: Copper, 90 parts; tin, 9 parts; 5% phosphor tin, 1 part. The mixture made according to this formula is poured into ingots, and then remelted and poured into sand castings. The remelting increases the strength.

3.—For ordinary work, when a medium strength is required, and when scrap must be used over and over again, the following mixture is recommended: Copper, 90 parts; tin, 8 parts; 5% phosphor tin, 2 parts. The scrap from this mixture may be used over and over again, with good results.

4.—Phosphor bronze, for use as bearings, which is one of the principal uses of phosphor bronze in machine-tool construction, must always contain lead. It is the lead which gives the bearing its "anti-frictional" qualities. The phosphorus prevents the separation of the lead. Lead may be present in the mixture up to 15%, but the majority of makers use less. Tin must be used in the mixture as well.

5.—A good general mixture of phosphor-bronze bearings is as follows: Copper, 80 parts; tin, 8 parts; lead, 10 parts; 5% phosphor tin, 2 parts. Zinc should never be present in phosphor bronze. It causes liquidation and formation of tin spots in a marked degree. Tin spots are small, hard, white masses in the interior of the casting. Frequently they are so hard that a file will not touch them. The excess of phosphorus in phosphor-bronze mixtures is also a cause of tin spots. The secret of success in producing phosphor bronze, in fact, is simply to keep the phosphor content down as low as possible in consistency with the serving of its purpose, and not to add any zinc.

6.—For the preparation of phosphorus compounds of metals, for example, phosphor copper, Dr. Schwarz gives the following directions: A mixture of bone ash, silica and carbon is placed in a crucible, and upon it a layer of granulated copper, which in turn is covered with the above mixture. The lid of the crucible is luted on. To make it melt more easily some carbonate of soda and glass may be added, or a mixture of pulverized milk glass with charcoal and powdered coke is used for lining and covering it. Take, for example, 14 parts of silica, 88 parts of bone ash, and 4 parts of powdered carbon. This is mixed with 4 parts of soda and 4 parts of powdered glass, stirred up with a little gum water, and used to line the crucible. When this is dry the copper is put in and covered with the same mass, and the whole is melted at a bright red heat. The copper obtained flows well, and has a reddish-gray color. It contains 0.50 to 0.51% of phosphorus. The simplest method for introducing phosphorus into bronze is to stick a bar of the phosphorus into a tube of pinchbeck, one end of which is hammered together, and closed tightly. After the phosphorus is put in, the other end is closed, too. When the metal, which contains 32 parts of copper to 5 parts of zinc and 1 part of tin, is melted, the tube charged with phosphorus is pushed down in it to the bottom of the crucible by means of bent tongs. The stick of phosphorus must always be kept under water until it is about to go

into the pinchbeck tube, when it must be carefully dried, as the presence of any moisture would be sure to cause the metal to spurt or fly about. Another way of introducing the phosphorus is as follows: Get about 2 ft. of iron barrel from a gas fitter; the bore a little larger than the sticks of phosphorus; make an iron plug to closely fit the bore, and then drive it down one end of the pipe until the space remaining will hold the quantity of phosphorus you wish to mix in the bath, minding not to split the barrel in driving in the plug. Make a plug of tin about ⅛ in. thick to fit in the bore; now introduce your phosphorus into the space formed by the iron plug, and just tap the tin plug into the end of the barrel with a hammer. Stir the tin-plugged end about in the molten metal; the tin plug soon melts, letting out the phosphorus in the bronze bath.

Rivet Metal.—1.—Copper, 32 oz.; tin, 2 oz.; zinc, 1 oz.

2.—*For Hose.*—Copper, 64 lb.; tin, 1 lb.

Silicon Bronze.—Silicon bronze is valuable on account of its great strength and tenacity, higher conductivity and resistance to corrosion by atmospheric influences, and is, therefore, one of the very best mediums for the transmission of electrical force. It can be made nearly as strong as steel, and yet possesses treble its conductivity. The manufacture of this alloy has been greatly improved since its introduction, the latest kinds possessing less conductivity for electricity, but a higher tensile strength, which allows the wire to be more tightly stretched and the supports wider apart. Wires of silicon bronze are largely used on the Continent for telephone purposes, and will stand the force of violent storms remarkably well, which is, in some measure, due to the small diameter of the conductor.

1.—Silicon copper and silicon bronze are made, according to Weiller, the inventor of these combinations, in the following manner. He recommends the following proportions: Potassium silicofluoride, 450 parts, by weight; powdered glass, 600 parts; common salt, 250 parts; carbonate of soda, 75 parts; carbonate of lime, 60 parts; dried chloride of calcium, 500 parts. The mixture is heated in a covered plumbago crucible to a temperature a little below the point when they begin to act on each other, when the mixture is added to the molten copper or bronze, as the case may be; the reduced silicon combining with the metal or alloy.

2.—Silicon Bronze.—Silicon, similarly to phosphorus, acts as a deoxidizing agent, and the bronzes produced under its influence are very ductile and elastic, do not rust, and are very strong. On account of these qualities, silicon bronze is much used for telegraph and telephone wires. The process of manufacture is similar to that of phosphor bronze; the silicon is used in the form of copper silicide. Some good silicon bronzes are as follows: (1) Copper, 97.12%; tin, 1.14%; zinc, 1.10%; silicon, 0.05%. (2) Copper, 97.37%; tin, 1.32%; zinc, 1.27%; silicon, 0.07%.

3.—In 1881, M. Weiller, of Angouleme, performed a series of experiments with phosphor-bronze wire, to test its suitability for telegraphic and telephonic conductors, and his results went to show that it possessed a conductivity one-third that of copper, but 2½ times that of iron and steel. The conductivity not being sufficient for telegraphic purposes, he invented silicon bronze, which is an alloy of copper and tin containing silicon. He thus obtained a wire presenting the same resistance to rupture as phosphor-bronze wire, but with a much higher degree of conductivity, rendering it applicable for telegraph purposes. Mr. W. H. Preece states that phosphorus has a most injurious influence on the electrical conductivity of bronze, and that silicon bronze is far superior, and has entirely replaced phosphor bronze for telegraphic purposes. It is also important to note that, although wires made from this alloy are very much lighter than ordinary wires, they are of equal strength. The following table shows the comparative properties of different wires:

Description of wire.	Tensile strength in tons per sq. in.	Resistance per mile, in ohms.	Relative conductivity.
Pure copper..........	17.78	33.1	100
Silicon bronze, telegraph	28.57	34.5	96
Silicon bronze, telephone	48.25	103	34
Phosphor bronze, 'phone	45.71	124	26
Swedish iron, galvanized	22.86	216	16
Bessemer steel, galv'zed	25.40	249	13
Siemens-Martin steel ..	26.67	266	12

Speculum Metal.—1.—Chinese Mirrors, Copper, 62 parts; tin, 32 parts; lead, 6 parts.

2.—Cooper's Mirror Metal.—Copper, 57.85%; platinum, 9.49%; zinc, 3.51%; tin, 27.49%; arsenic, 1.66%. The inventor claims for this alloy that it is indifferent to the weather, and takes a beautiful polish.

3.—Reflector Metal, Duppler's.—a.—Silver, 80 parts; zinc, 20 parts.

b.—Copper, 66.22 parts; tin, 33.11 parts; arsenic, 0.67 part.

4.—English alloy, 66.6% copper, 33.4% tin; Ross's alloy, 68.21% copper, 31.79% tin; ancient mirror, 62% copper, 32% tin, 6% lead; Richardson's alloy, 65.3% copper, 30% tin, 0.7% zinc, 2% arsenic, 2% silver; Sallit's alloy, 64.6% copper, 31.3% tin, 4.1% nickel; Chinese alloy, 80.83% copper, 11.67% tin, 8.5% antimony.

5.—Alloys consisting of 2 parts of copper and 1 part of tin can be very brilliantly polished, and will serve for mirrors. The mirrors of the most ancient people were pieces of the mineral called iron pyrites, smoothly polished. Metallic mirrors were first used by the civilized nations of the East, and were made partly of copper alone and partly of special alloys; only the wealthy had mirrors made from the precious metals. The alloy best suited for this purpose is the above mentioned compound of copper and tin; but at the present time it is only used in the construction of mirrors for optical instruments, especially large telescopes, and even here is being gradually displaced by glass. Good speculum metal should have a very fine-grained fracture, should be white, and very hard, the highest degree of polish depending upon these qualities. A composition to meet these requirements must contain at least 35 to 36% of copper. Attempts have frequently been made to increase the hardness of speculum metal by additions of nickel, antimony and arsenic. With the exception of nickel, these substances have the effect of causing the metal to easily lose its high luster, any considerable quantity of arsenic in particular having this effect. The real speculum metal seems to be a combination of the formula Cu_4Sn, composed of 68.21% of copper and 31.7% of tin. An alloy of this nature is sometimes separated from ordnance bronze by incorrect treatment, causing the so-called tin spots; but this has not the pure white color which distinguishes the speculum metal containing 31.5% of tin. By increasing the percentage of copper the color gradually shades into yellow; with a larger amount of tin, into blue. It is dangerous to increase the tin too much, as this changes the other properties of the alloy, and it becomes too brittle to be worked. We give below different compositions of speculum metal. The standard alloy, already mentioned, is undoubtedly the best. Standard alloy, 68.21% copper, 31.7% tin; Otto's alloy, 68.5% copper, 31.5% tin; Richardson's alloy, 65.3% copper, 30% tin, 0.7% zinc, 2% arsenic, 2% silver;

Little's alloy, 65% copper, 30.8% tin, 2.2% zinc, 1.9% arsenic; Chinese speculum metal, 80.83% copper, 8.5% antimony; old Roman, 63.39% copper.

6.—Table of Speculum Alloys.

Silver.	Brass.	Copper.	Tin	Arsenic.
..	..	32	14	2
..	..	32	13½	1½
..	..	6	2	1
..	..	32	2	1
..	..	3	1¼	..
..	..	64	29	..
1	1	32	15	..

In using arsenic, it must be introduced into the crucible when the mixture is in a melting state. Being in a coarsely pounded state, it is tied up in a paper bag and let into the crucible by a pair of tongs. The whole mixture requires to be stirred with a birch rod till vapors cease to rise. Avoid breathing or inhaling while the vapors appear; as soon as they are over the alloy is ready for pouring. Arsenic renders alloys white and hard. The alloys containing arsenic should be taken out of the flask as soon as properly set, and placed in hot ashes, and in a proper place for protracted annealing.

7.—Equal parts of tin and copper form a white metal as hard as steel. Less tin and a small quantity of arsenic added to the alloy forms a white, hard metal of high luster. Copper, 2 lb.; tin, 1 lb.; arsenic, 1 oz., form a good speculum metal. An alloy of 32 parts copper, 16.5 parts tin, 4 parts brass and 1.25 parts arsenic is hard, white, and of brilliant luster.

8.—Specular Alloys.—These are employed for making metallic reflectors, requiring a true white color, good luster, and a hard, clean surface, not easily tarnished or scratched. Fesquet gives a number of combinations as follows: (1) Copper, 62 parts; tin, 32 parts; lead, 6 parts. (2) Copper, 80 parts; lead, 10 parts; antimony, 10 parts. (3) Copper, 66 to 63 parts; tin, 33 to 27 parts. (4) Copper, 10 parts; tin, 10 parts; antimony, 10 parts; lead, 50 parts. (5) Copper, 32 parts; tin, 50 parts; silver, 1 part; arsenic, 1 part. (6) Steel, 90 parts; nickel, 10 parts. (7) Palladium, 50 parts; silver, 50 parts. (8) Platinum, 60 parts; copper, 40 parts. (9) Platinum, 50 parts; steel, 50 parts. (10) Platinum, 50 parts; iron, 50 parts. (11) Platinum, 10 parts; steel, 90 parts. (12) Platinum, 20 parts; copper, 80 parts; arsenic, 0.5 to 1 part. (13) Platinum, 60 parts; iron, 30 parts; gold, 10 parts.

(14) Gold, 50 parts; zinc, 50 parts. (15) Steel, 50 parts; rhodium, 50 parts. (16) Platinum, 10 parts; iridium, 90 parts. (17) Tin, 29 parts; lead, 19 parts. (18) Copper, 52 parts; nickel, 30 parts; zinc, 12 parts; lead, 5 parts; bismuth, 1 part. Good speculum metal should be pure white, of a fine-grained structure, perfectly sound and homogeneous when cast, and sufficiently tenacious to stand grinding and polishing without rupture. It should contain 65 to 68% of copper to comply with these requisites.

White Alloy.—1.—Copper, 64.5%; tin, 32%; arsenic, 3.5%.

2.—Copper, 59%; tin, 31%; brass, 8%; arsenic, 2%.

Copper-Zinc. (See also IMITATION GOLD.)

Specific Weight and Strength of Alloys of Copper and Zinc.—The specific gravity always decreases as the content of zinc increases; in alloys with 70 or 80% of zinc there is a marked compression. The specific weight of alloys which contain larger quantities of zinc is raised by mechanical working and in cooling, but can be lowered again to a large degree by annealing. Some weights of copper and zinc alloys are given below:

Copper.	Zinc.	Specific Weight.
100.00	....	8.890
90.65	9.35	8.834
85.34	14.63	8.584
79.51	20.49	8.367
69.98	34.02	8.390
59.28	40.74	8.329
49.23	50.76	8.304
39.27	60.73	8.171
32.66	67.14	8.084
19.52	80.48	7.863
10.82	89.18	7.315
....	100.00	7.206

The greatest strength is shown in the alloys containing from 20 to 30% of zinc; if the percentage is above 60% the strength is considerably diminished, even to the extent of making the alloy unsuitable for most technical purposes. The hardness of the copper is increased by the addition of zinc, and alloys containing 49.5 to 50% of zinc are harder than with a larger percentage of copper. If the percentage of zinc is higher than this, the alloy becomes so brittle that the degree of hardness cannot be determined. The determination becomes possible again with a percentage of 89.2% of zinc, and the hardness of this alloy is not much less than that of alloys with 49.5% of copper.

Aich's Metal.—Aich's metal, named

after its inventor, is a variety of brass with an admixture of iron, which gives it a considerable degree of tenacity. It is especially adapted to purposes which require a hard and at the same time tenacious metal. Analyses of the various kinds of this metal show considerable variation in the proportions of the metals used in preparing it. Even the amount of iron, to which the hardening effect must be attributed, may vary within wide limits without materially modifying the tenacity, which is the essential characteristic of this alloy. The best variety of Aich's metal consists of copper, 60 parts; zinc, 38.2 parts; iron, 1.8 part. The predominating quality of this alloy is its hardness, which is claimed to be not inferior to that of certain kinds of steel. It has a beautiful golden-yellow color, and is said not to oxidize easily, a valuable property for articles exposed to the action of air and water. Another Aich's metal of excellent quality is composed of copper, 60.2 parts; zinc, 38.2 parts; iron, 1.6 part. The permissible variations in the content of iron are from 0.4 to 3%.

Albata Metal.—Copper, 40 lb.; zinc, 32 lb.; nickel, 8 lb.

Alfenide.—Copper, 60%; zinc, 30%; nickel, 10%; iron, a trace.

Bearing Metals.

Alloys, Bearing.—1.

	Copper.	Tin.	Zinc.
Ordinary bearings	84.5	13.3	2.2
Ordinary bearings	83.6	12.6	3.8
Heavy bearings	84.	12	4
Heavy bearings	77	9	14
Main bearings	75	4	21
Locomotive axles	86	..	14
Locomotive axles	82	10	8
Moderately hard axles	70	22	8
Hard axles	82	16	2
Very hard axles	89	..	11

Copper Alloy Bearing Metals.—2.—The bearings of heavy axles, especially such as revolve rapidly, as, for example, the bearings of railroad wheels, are made, as a rule, from alloys which contain much copper (from 80 to 90%), and which may, therefore, be classed among bronzes. Those containing the most copper have the valuable property of being malleable in heat, a property lacking in those which are poor in copper. A table is annexed giving the composition of some of the more important varieties of the metals of this class, and the purposes for which they are especially used. It will be found, however, that nearly every large machine foundry uses a different alloy for the same purpose. This can only be explained by the difference in the quality of the metal worked. It is evident from what has previously been said with regard to the influence of small quantities of foreign metals upon the character of an alloy, that a foundry which can obtain, for instance, only copper with a content of iron, will use a different alloy from one which works pure copper. This applies equally to all impurities present in metals; and it would mark a great advance in the technics of alloys if we were able to procure the metals for alloys, in a chemically pure state, at a low price. The result would be that the number of alloys for each certain purpose would be lessened, and the same composition would be used in all foundries.

Metals for Bearings

	Copper.	Zinc.	Tin.
Locomotive axles	86.0	14.0	..
Locomotive axles	82.0	8.0	10.0
Car axles	82.0	18.0	..
Car axles	84.0	16.0	..
Car axles	75.0	2.0	20.0
Various axles	73.7	2.1	14.2
Various axles, medium hard	69.55	5.88	21.77
Various axles, hard	82.0	2.0	16.0
Various axles, very hard	88.8	11.2	..

Machine Metals for Various Purposes

	Copper.	Zinc.	Tin.	Lead.
Cogwheels	91.3	8.7	..	..
Punches	83.3	16.7	..	..
Steam whistles	80.0	2.0	17.0	..
Steam whistles	81.0	2.0	16.0	..
Cocks	88.0	2.0	10.0	..
Wheel boxes, for wagons	87.7	2.6	9.7	..
Stuffing boxes	86.2	3.6	10.2	..
Mec'l instrum'ts	81.2	5.1	12.8	..
Files	64.0	10.0	17.6	8.6
Files	61.5	7.7	30.8	..
Weights	90.0	2.0	8.0	..
Castings, to be gilded	79.1	7.8	13.1	..
Castings, to be gilded	77.2	7.0	15.8	..
Piston rings	84.0	8.3	2.9	4.3
Malleable shovels	50.0	16.4	33.6	..
Malleable shovels	3.0	2.0	1.0	..
Buttons, white	57.9	36.8	5.3	..
Sheet for p[illegible]ed articles	63.88	30.55	5.55	..
Small castings	94.12	..	5.88	..
Small castings	90.0	10.0	..	..

3.—Dysiot.—A bearing metal. It is composed of 60 or 62 parts of copper, 18 parts of lead, and 10 parts each of tin and zinc.

Brass.

The term brass signifies all alloys of which copper and zinc are the essential and chief constituents; but it is generally limited in the industrial arts to those alloys which are decidedly yellow, or have the yellowish tint characteristic of ordinary brass. Alloys of zinc and copper are known in commerce by a variety of names, and, indeed, great confusion has been introduced by the multiplication of empirical names to represent one and the same substance. This is doubtless owing to the ignorance that formerly prevailed, when every mixture was jealously guarded as a great secret, and fanciful names given to hide the real composition. Moreover, some alloys have been handed down to us from very early times, and their names corrupted so as to have different appellations in different localities. Copper and zinc may be united in all proportions, forming homogeneous alloys; and the combination is usually attended with evolution to heat. Certain varieties of brass are exceedingly malleable and ductile, and these properties, combined with the variety of shades of color obtained by suitable mixing, and the moderate cost, render copper-zinc alloys most valuable for ornamental purposes. Brass possesses all the necessary advantages as a constructive material for works of art, and with the aid of transparent varnishes, termed lacquers, which have been brought to great perfection, it resists the action of the atmosphere remarkably well. The malleability of brass varies with the composition, with the temperature, and with the presence of foreign metals, which are sometimes in minute quantities. Some varieties are only malleable when rolled hot, others can be rolled at any temperature. Alloys containing up to 35% zinc can be drawn into wire, but those containing 15 to 30% of zinc are the most ductile. The alloy known as Dutch metal, which is an alloy of copper and zinc, containing more copper than ordinary brass, is an example of the great malleability of certain kinds of brass. The thickness of the leaves of Dutch metal is said not to exceed 1-52900 of an inch. Brass is harder than copper, and therefore better adapted to resist wear and tear. It acts well under the influence of a percussive force, as in the process of stamping, provided it is suitably annealed at proper intervals, in order to counteract the effects of local hardening, due to the compression of the particles into what may be termed unnatural positions. During the ordinary process of annealing the metal becomes coated with a scale of oxide, by union with the oxygen of the air, which oxide requires to be removed at each stage. This is done by dipping the metal in aquafortis, or dilute sulphuric acid, then scouring with sand if necessary, and finally well rinsing in water. A piece of brass submitted to permanent deformation by mechanical treatment, such as rolling, is more or less hardened, and its limit of elasticity is raised. Between soft and hard brass there are many shades of difference. With the same rolled brass the author has obtained tensile strengths varying from 15 to 25 tons per square inch before and after annealing. The temperature employed for annealing is of the greatest importance.

Some varieties of Modern Brass

	Name.	Color.	Copper.	Zinc.	Tin.	Lead.	Iron.
1.	Jewelers' gilding alloy	Red	94	6	..	..	..
2.	Jewelers' gilding alloy	Red	90.5	7.9	..	1.6	..
3.	Pinchbeck	Reddish yellow	88.8	11.2	..	..	..
4.	Oreide (French gold)	Reddish yellow	90	10	..	..	..
5.	Talmi gold*	Gold	90.70	8.33	..	..	..
6.	Tissier's metal, with 1% arsenic	Red	97	2	..	..	..
7.	Tournay's alloy	Yellow	82.54	17.46	..	..	..
8.	Rich sheet brass	Yellow	84	16	..	..	..
9.	Bath metal, similar, etc	Yellow	80	20	..	..	..
10.	Dutch alloy	Yellow	76	24	..	..	..
11.	Bristol sheet brass	Bright yellow	72.8	27	..	0.2	..
12.	Brass wire	Bright yellow	70	30	..	..	..
13.	Prince's metal	Yellow	75	25	..	..	..
14.	Sheet and wire brass	Full yellow	67	33	..	..	..
15.	Mosaic gold, ordinary brass	Full yellow	66.6	33.3	..	..	..
16.	Bobierre's metal	Full yellow	66	34	..	..	..
17.	Muntz's metal	Full yellow	62	38	..	..	..
18.	Muntz's metal	Full yellow	60	40	..	..	..

(Brass)			(Brass)				
	Name.	Color.	Copper.	Zinc.	Tin.	Lead.	Iron.
19.	Gedge's metal	Full yellow	60	38.5	..	..	1.5
20.	Common brass	Full yellow	64	36	..	..	
21.	Aich's metal.	Full yellow	60	38.2		..	1.8
22.	French brass (Potin jaune)	Gray yellow	71.9	24.9	1.2	2.0	..
23.	Hamilton's metal, chrysorin	Full yellow	64.5	32.5	0.3	2.7	..
24.	French brass for fine castings	Full yellow	71	24	2	3	.
25.	Sterro metal		55.5	42	..	..	2.5
26.	Hard solder for copper or iron		57	43	..	..	..
27.	Hard solder for brass		50	50	..	..	..
28.	Dipping brass		53	47	.	..	..
29.	White brass		34	66	..	..	..
30.	Lap alloy		12.5	87.5	..	..	..

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* Also contains 0.97% gold.

Brass.—Table of Various Copper-Zinc Alloys.

	Name.	Authority.	Copper.	Zinc.	Tin.	Lead.	Iron.
1.	Brass, English.	Lavater	70.29	29.26	0.17	0.28	..
2.	Brass, Heegermuhl.	Lavater	70.16	27.45	0.79	0.2	..
3.	Brass, Augsburg.	Lavater	70.89	27.63	0.85	..	..
4.	Brass, Neustadt.	Kadernatsch.	71.36	28.15	..	..	..
5.	Brass, Romilly	Chaudet.	70.1	29.9	..	..	..
6.	Brass, unknown.	Karsten	71.5	28.5	..		..
7.	Brass, unknown.	Regnault.	71.0	27.6	trace	1.3	..
8.	Brass, unknown.	Chaudet.	61.59	35.33	0.25	2.86	..
9.	Brass, Stolberg.	Chaudet.	65.8	31.8	0.25	2.15	..
10.	Watch wheels	Faisst.	60.66	36.88	1.35	..	0.74
11.	Watch wheels	Faisst.	66.06	31.46	1.43	..	0.88
12.	Ship nails, bad	Percy	52.73	41.18	.	4.72	..
13.	Ship nails, good	Percy	62.62	24.64	2.64	8.69	..
14.	Tombac, English.	Faisst.	86.38	13.61	..	..	trace
15.	Tombac, German	Karsten	84.0	15.5	..	..	..
16.	Coin of Titus Claudius	Giraldin	81.4	18.6	..	..	..
17.	Coin of Titus, 79 A.D.	Phillips	83.04	15.84		..	0.5
18.	Coin of Hadrian, 120 A.D.	Phillips	85.67	10.83	1.14	1.73	0.74
19.	Coin of Faustina, Jr., 165 A.D.	Phillips	79.15	6.67	4.97	9.18	0.23
20.	Antique bracelet, Naumberg	Goebel	83.08	15.38	1.54	..	..
21.	Statue of Louis XIV	D'Arcet	91.40	5.53	1.7	1.37	..
22.	Statue of Napoleon	D'Arcet	75	20	3	2	..
23.	Brass for gilding	D'Arcet	82	15.5	2.5	..	..
24.	Brass	D'Arcet	64.5	32.5	2.5	..	..
25.	Brass	D'Arcet	82	15	3	..	..
26.	Brass	D'Arcet	78	20	2	..	..
27.	Brass, color pale yellow	Konig.	82.33	16.69	..	..	..
28.	Brass, color deep yellow	Konig.	84.5	15.3	..	..	..
29.	Brass, color red yellow	Konig.	90	9.6	..	..	..
30.	Brass, color orange	Konig.	98.93	0.73	..	..	..
31.	Brass, color copper-red	Konig.	99.9	..	..	..	0.08
32.	Brass, color violet	Konig.	98.22	0.5	trace	..	trace
33.	Brass, color green	Konig.	84.32	15.02	trace	..	0.3

Machine Brasses

	Copper.	Tin.	Zinc.	Lead.
Eccentric rings	90	7.7	2.3	..
Eccentric rings	66	15.5	18.5	..
Pumps	84	7	9	..
Pumps	34	50	16	..
Kingston valve	84.2	10.5	5.3	..
Cocks and glands	81	3	13	3

	Copper.	Tin.	Zinc.	Lead.
Paddle-wheel pins	76.8	17.4	5.8	..
Sluice cockway	81	..	19	..
Propeller blades and boxes	57	14	29	..
Hydraulic pumps	81	..	19	..
Propeller shaft liner	80	5.4	14.6	..

	Copper.	Tin.	Zinc.	Lead.
White metal bush for propeller. . .	5	26	69	. .
Cogwheels	91	. .	9	. .
Steam whistles . . .	80	17	3	. .
Stuffing boxes . . .	86	11	3	. .
Mech'l instruments	82	13	5	. .
Piston rings	84	2.9	8.3	4.8
Stevenson's socket alloy	19	31	19	31
Sterro metal for pumps*	55	6	22.5	. .
Valve balls†	87	12	. .	. .

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* Also contains 16.5% iron.

† Also contains 1% antimony.

The following mixtures are employed by a large engineering firm, using scrap and new metal:

	Bearing brasses.	Eccentric pumps.	Pumps.	Cocks and glands.	Sluice cockway.
Copper ...	38	38	38	38	38
Spelter ...	1	1	4	6	9
Lead	. .	.	. .	1½	. .
Tin	7	4	3	1½	. .
Old metal. .	54	57	55	53	53

	Bearing brasses.	Eccentric pumps.	Kingston valve.	Paddle-wheel pins.	Propeller blades and boxes.
Copper ...	65	28	112	56	16
Tin	8½	6½	14	12½	4
Spelter ...	2½	7½	. .	3½	8
Old metal. .	45	70	7	40	84

	Heavy bearings.	Heavy bearings.	Main bearings.	Propeller shaft liner.
Ingot copper....	16	16	16	56
Block tin........	2¼	3	2-3	6
Zinc	¾	. .	. .	. .
Old brass........	. .	13	32	50

Hydraulic Pumps.—Ingot copper, 14 lb.; zinc, 1½ lb.; yellow brass, 3½ lb.; or spelter, 1¾ lb.

White Metal Bush for Propeller Shaft. —Ingot copper, 6 lb.; tin, 84 lb.; spelter, 32 lb.

Brass, Button.—1.—(Best.) Copper, 8 parts; zinc, 5 parts.

2.—(Common.) Copper, 50 parts; zinc, 40 parts; tin, 4 parts; lead, 6 parts.

3.—Copper, 129 parts; zinc, 201 parts.

Best Red Brass for Fine Castings.—Copper, 24 lb.; zinc, 5 lb.; bismuth, 1 oz. Put in the bismuth last, before pouring off.

Hard Brass, for Casting.—Copper, 25 parts; zinc, 2 parts; tin, 4.5 parts.

Bath Metal.—A species of brass having the following composition: (1) Zinc, 3 parts; copper, 16 parts; melted together under charcoal. (2) Fine brass, 32 parts; spelter, 9 parts.

Bobierre's Metal.—This is ordinary brass, consisting of 66 parts copper and 34 parts zinc. Bobierre introduced this alloy as especially suitable for ships' sheathing.

Bristol Brass.—Copper, 61%; zinc, 39%.

Casting Objects in Brass.—1.—If it is desired to cast brass objects in sand, it is recommended not to make use of alloys containing more than 30% of zinc. This is an alloy which furnishes a good color, casts neatly, and flows well. One may add to it either tin or lead without seriously modifying its properties. A good formula is one giving 3.20 kgm. of copper, 1.36 kgm. of zinc, 120 grams of tin and 90 grams of lead. The product thus obtained is capable of great resistance, and it may be rendered still harder by slightly increasing the amount of tin.

French Cast Brass for Fine Castings. —2.—We are familiar with various articles of bronze, so called, statuettes, clock cases, etc., made in France, where this industry has attained great perfection and extensive proportions. The material, however, is not, in most cases, genuine bronze, but fine cast brass. In the following table is given the composition of a few mixtures of metals most frequently used by French manufacturers:

	Copper.	Zinc.	Tin.	Lead.
I...............	63.70	33.55	2.50	0.25
II..............	64.45	32.44	0.25	2.86
III............	70.90	24.05	2.00	3.05
IV............	72.43	22.75	1.87	2.95

Their special advantage is that they can be readily cast, worked with file and chisel, and easily gilded.

Chrysocale.—Copper, 9 parts; zinc, 8 parts; lead, 2 parts.

Delatot's Alloy.—Copper, 80 parts; manganese, 2 parts; zinc, 18 parts; calcium phosphate, 1 part. It is rather difficult to prepare. Remove the scoria and add the zinc just before casting.

Delta Metal.—An alloy widely used for making parts of machinery, and also for artistic purposes, is the so-called Delta metal. This is a variety of brass hardened with iron; some manufacturers add small quantities of tin and lead, also, in some cases, nickel. The following analyses of Delta metal (from the factory at Dusseldorf) will show its usual composition:

	I.	II.	III.	IV.	V.
Copper..	55.94	55.80	55.82	54.22	58.65
Zinc.....	41.61	40.07	41.41	42.25	38.95
Lead.....	0.72	1.82	0.76	1.10	0.67
Iron	0.87	1.28	0.86	0.99	1.62
M'ganese.	0.81	0.96	1.38	1.09	....
Nickel ..	*	*	0.06	0.16	0.11
Phosph's.	0.013	0.011	*	0.02	....

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*Slight traces.

I is cast, II is hammered, III rolled, and IV hot-stamped metal. Delta metal is produced by heating zinc very strongly in crucibles (to above 900°C.) and adding ferro-manganese or "spiegeleisen," producing an alloy of 95% of zinc and 5% of iron. Copper or brass, and a very small amount of copper phosphate, are also added.

Fine Brass.—1.—Copper, 2 parts; zinc, 1 part. This is nearly 1 equivalent each of copper and zinc, if the equivalent of the former metal be taken at 63.2; or 2 equivalents of copper to 1 equivalent of zinc, if it be taken, with Liebig and Berzelius, at 31.6.

2.—Copper, 4 parts; zinc, 1 part. An excellent and very useful brass.

3.—This alloy, which possesses properties similar to varieties of French brass, is prepared in the following proportions: (I) Copper, 75.7%; zinc, 24.3%. (II) Copper, 67.2%; zinc, 32.8%. (III) Copper, 60.8%; zinc, 39.2%. Particular care is required to prevent the zinc from evaporating during the fusing, and to this purpose it is customary to put only half of it into the first melting, and to add the remainder when the first mass is liquid.

Gilding Metals.—Copper, 4 parts; brass (containing 3 parts of copper and 1 part of zinc), 1 part; and 70 parts of tin for each 80 parts of copper.

Gold-colored Brass.—*Syn.* Red brass, Dutch gold, tombac, similor, Prince's metal, pinchbeck, etc. (See GOLD ALLOYS; GOLD SUBSTITUTES.)

Macht's Yellow Metal.—This alloy consists of 33 parts of copper and 25 parts of zinc. It has a dark golden yellow color, great tenacity, and can be forged at a red heat, properties which make it especially suitable for fine castings.

Malleable Brasses.—Aich's, Bobierre's, Macht's, and Muntz metals, Bristol brass, etc. (For composition see under those headings.)

Experiments with malleable brass show that all alloys containing up to 58.33% of copper and up to 41.67% of zinc are malleable. There is in addition a second group of such alloys, with 61.54% of copper and 38.46% of zinc, which are also malleable in heat. The preparation of these alloys requires considerable experience, and is best accomplished by melting the metals together in the usual manner and heating the fused mass as strongly as possible. It must be covered with a layer of charcoal dust to prevent oxidation of the zinc. The mass becomes thinly fluid, and an intimate mixture of the constituents is effected. Small pieces of the same alloy are thrown into the liquid mass until it no longer shows a reflecting surface, when it is cast into ingots in iron molds. The ingots are plunged into water while still red hot, and acquire by this treatment a very high degree of ductility. The alloy, properly prepared, has a fibrous fracture and a reddish yellow color.

Medals, Metal for.—Copper, 50 parts; zinc, 4 parts.

Muntz Metal.—1.—Copper, 6 parts; zinc, 4 parts. Can be rolled and worked at a red heat.

2.—Composition Tacks for Muntz Metal on Ships.—Zinc, 2 parts; tin, 4½ parts; copper, 43½ parts.

3.—This metal is less affected by sea water than pure copper, and was formerly much used for ship sheathing, and for making nails and rivets which were to come in contact with sea water. At the present day it has lost much of its importance, since all the larger ships are made of iron. It is usually composed of 60 to 62 parts of copper and 40 to 38 parts of zinc. Yellow metal, or Muntz metal (so called, after its inventor), is prepared with certain precautions, directed toward obtaining as fine a grain as possible, experience having shown that only a fine-grained alloy of uniform density can resist the action of sea water evenly. A metal of uneven density will wear in holes. To obtain as uniform a grain as possible, small samples taken from the fused mass are cooled quickly, and examined as to fracture. If they do not show the desired uniform grain some zinc is added to the mass. After it has permeated the whole mass a fresh sample is taken and tested, this being continued until the desired result is reached. It is scarcely necessary to remark that considerable experience is required to tell the correct composition of the alloy from the fracture. The mass is finally poured into molds and rolled cold. (See also IMITATION GOLD.)

Neogen.—Copper, 58 parts; zinc, 27 parts; tin, 2 parts; nickel, 12 parts; bismuth, ½ part; aluminum, ½ part.

Ornaments.—1.—Copper, 82 parts; tin, 3 parts; zinc, 18 parts; lead, 2 parts.

2.—Copper, 83 parts; zinc, 17 parts; tin, 1 part; lead, ⅛ part.

Potin.—Copper, 71.9%; zinc, 24.9%; tin, 1.2%; lead, 2%.

Rolled Brass.—Copper, 32 parts; zinc, 10 parts; tin, 1 to 5 parts.

Rollers and Scrapers for Calico Printing.—For this purpose a metal is required that is sufficiently soft to be worked by tools, and hard enough to resist the wear to which it is subjected in practice. Another important desideratum is that the metals should be capable of resisting the corrosive action of the liquids with which they come in contact. Hauvel considers a bronze having the following composition the best material for the rollers: Copper, 84; tin, 14; zinc, 2. Another alloy which is used consists of zinc, 78.5; tin, 15.8; copper, 5.6.

	Copper.	Zinc.	Tin.
French scrapers	78.75	12.50	8.75
English scrapers	80.50	11.50	8.00
German scrapers	85.30	9.80	4.90

Sheet Brass (for Sheet and Wire).—In the preparation of brass for the manufacture of wire, an especially pure quality of copper must be used; without this, all efforts to produce a suitable quality of brass will be in vain. That pure copper is indispensable to the manufacture of good, ductile brass, may be seen from the great difference in the composition of the various kinds, all of which answer their purpose, but contain widely varying quantities of copper and zinc. The following table shows the composition of some excellent qualities of brass suitable for making sheet and wire:

	Copper.	Zinc.	Lead	Tin
Brass sheet.	%	%	%	%
Jemmapes	64.6	33.7	1.4	0.2
Stolberg	64.8	32.8	2.0	0.4
Romilly	70.1	29.26	0.38	0.17
Rosthorn, Vienna ..	68.1	31.9	....	....
Rosthorn, Vienna ..	71.5	28.5	....	....
Rosthorn, Vienna ..	71.1	27.6	1.3	....
Iserlohn & Romilly	70.1	29.9	....	....
Ludenscheid	72.73	27.27	....	....
(Brittle)	63.66	33.02	2.52	....
Hegermuhl	70.16	27.45	0.79	0.20
Oker	68.98	29.54	0.97	....
Brass wire.				
England	70.29	29.26	0.28	0.17
Augsburg	71.89	27.63	0.85	....
Neustadt	70.16	27.45	0.2	0.79
Neustadt	71.36	28.15	....	....
Neustadt	71.5	28.5	....	....
Neustadt	71.0	27.6	....	....
(Good quality)	65.4	34.6	....	....
(Brittle)	65.5	32.4	2.1	....
For wire and sheet	67	32	0.5	0.5

As the above figures show, the percentage of zinc in the different kinds of brass lies between 27 and 34. Recently, alloys containing a somewhat larger quantity of zinc have been used, it having been found that the toughness and ductility of the brass are increased thereby without injury to its tenacity. Alloys containing up to 37% of zinc possess a high degree of ductility in the cold, and are well adapted for wire and sheet.

Statuary Metal.—Copper, 91.4 parts; zinc, 5.53 parts; tin, 1.7 parts; lead, 1.37 parts. Or, copper, 80 parts; tin, 20 parts.

Sterro Metal.—The alloy called sterro metal may properly be considered in connection with Aich's metal, since its constituents are the same, and its properties very similar. The principal difference between the two metals is that sterro metal contains a much larger amount of iron. The composition of this alloy, which is sure to have an important part in the future development of the metal industry, varies considerably with different manufacturers. Two varieties of excellent quality are the product of the Rosthorn factory, in Lower Austria—copper, 55.33 parts; zinc, 41.80 parts; iron, 4.66 parts; and the English sterro metal (Gedge's alloy for ship sheathing), copper, 60 parts; zinc, 38.125 parts; iron, 1.5 parts. The great value of this alloy lies in its strength, which is equaled only by that of the best steel. As an illustration of this, a wrought-iron pipe broke with a pressure of 267 atmospheres, while a similar pipe of sterro metal withstood the enormous pressure of 763 atmospheres without cracking. Besides its remarkable strength, it possesses a high degree of elasticity, and is, therefore, particularly suitable for purposes which require the combination of these two qualities, such as the construction of hydraulic cylinders. It is well known that these cylinders, at a certain pressure, begin to sweat; that is, the interior pressure is so great that the water permeates through the pores of the steel. With a sterro-metal cylinder, the pressure can be considerably increased without any moisture being perceptible on the outside of the cylinder. Sterro metal can be made even more hard and dense, if required for special purposes, but this is effected rather by mechanical manipulation than by any change in the chemical composition. If rolled or hammered in heat, its strength is increased, and it acquires, in addition, an exceedingly high degree of tenacity. Special care must be taken, however, in hammering not to overheat the metal, as in this case it would become brittle, and might crack under the hammer. Sterro metal is especially suitable for all the purposes for which the so-called red metal has been in the past almost exclusively used. Axle bearings, for example, made of sterro metal, have such excellent qualities that many machine factories are now using this material entirely for the purpose.

Tissier's Metal.—This alloy differs from the ones previously described in containing arsenic. It is of a beautiful tombac red color, and very hard. Its composition varies a great deal, but the peculiar alloy which gives the name is composed of 97 parts of copper, 2 parts of zinc, and 1 or 2 parts of arsenic. It may be considered a brass with a very high percentage of copper, and hardened by the addition of arsenic. It is sometimes used for axle bearings, but other alloys are equally suitable for this purpose, and are to be preferred on account of the absence of arsenic, which is always dangerous.

Tobin Bronze.—This alloy is very similar in composition and properties to Delta metal. Some analyses are given:

	I.	II.	III.	IV.
Copper	61.203	59.00	61.20	82.67
Zinc	27.440	38.40	37.14	3.23
Tin	0.906	2.16	0.90	12.40
Iron	0.180	0.11	0.18	0.10
Lead	0.359	0.31	0.35	2.14
Silver	....	....	....	0.07
Phosphorus	....	....	....	0.005

The alloy marked IV is called in commerce deoxidized bronze.

Compositions of Sheet Brass

Copper.	Zinc.	Tin.	Lead.
92.7	4.6	2.7	..
91.6	8.4	..	..
90	10	..	..
85.5	14.5	..	..

Copper.	Zinc.	Tin.	Lead.
83	17	..	..
79.5	20	..	0.5
76	24	..	..
75	25		..
73.5	26.2	0.3	..
70	30	..	..
68	32		..
67	32	0.5	0.5
66	34	..	..
65	35	..	..

1.—Solder for Brass.—Syn. Hard Solder. Brass, 12 parts; zinc, 6 parts; tin, 1 part; melted together.

2.—Brass, 2 parts; zinc, 1 part.

3.—Very strong. Brass, 3 parts; zinc, 1 part.

1.—Turner's Brass.—Brass, 98 parts; lead, 2 parts. The addition of lead improves the brass for the use of the turner, but lessens its malleability.

2.—Copper, 32 lb.; zinc, 10 lb.; lead, 1 lb.

3.—Red Brass.—a.—Copper, 24 lbs.; zinc, 5 lbs.; lead, 8 oz. Put in the lead last, before pouring off.

b.—Free, for Turning.—Copper, 160 lb.; zinc, 50 lb.; lead, 10 lb.; antimony, 44 oz.

4.—Yellow Brass (common article).—Copper, 20 lb.; zinc, 10 lb.; lead, 1 to 5 oz. Put in the lead last, before pouring off.

White Brasses.—Below are given proportions for white brasses, as they are called. They can all be melted on a good hot fire; but a coke stove, in which a slight blast could be obtained, would be better still:

	1	2	3	4	5	6	7‘	8
Lead	70		42.5	37.5	....	..	..	84
Zinc	..	82	42.5	..	....	..	..	84
Tin				37.5	66.7	90	85	..
Antimony	20	11	15	25	11.1	7	10	16
Copper ..	10	7	....	....	22.2	3	5	..

Ordinary brass can be melted over an ordinary open fire.

Wire, Brass for.—For wire, an alloy of 72 parts of copper and 28 parts of zinc is commonly used; this alloy must be afterward hardened by tempering.

Yellow Brass.—Zinc, 30 parts; copper, 70 parts; in small pieces.

GOLD

Aluminum and Gold Alloy.—This alloy, called Nuremberg gold, is used for making cheap gold ware, and is excellent for this purpose, as its color is exactly that of pure gold, and does not change in the air. Articles made of Nuremberg gold need no gilding, and retain their color under the hardest usage; even the fracture of this alloy shows the pure gold color. The composition is usually 90 parts of copper, 2.5 parts of gold, and 7.5 parts of aluminum.

Chains, Alloy for.—1.—Fine gold, 11 dwts. 6 gr.; fine silver, 2 dwts. 5 gr.; fine copper, 6 dwts. 13 gr.

2.—Fine gold, 1 oz.; fine silver, 9 dwts.; fine copper, 8 dwts.

Colored Gold.—The alloys of gold with copper have a reddish tinge, those of gold with silver are whiter, and an alloy of gold, silver and copper together is distinguished by a greenish tone. Manufacturers of gold ware make use of these different colors, one piece being frequently composed of several pieces of varying color. Below are given some of these alloys, with their colors:

1.—

Gold.	Silver.	Copper.	Steel.	Cadmium.	Color
2 to 6	1.0	..	..	....	Green
75.0	16.6		..	8.4	Green
74.6	11.4	9.7	..	4.3	Green.
75.0	12.5	12.5	..	12.5	Green
1.0	2.0		..	....	Pale yellow
4.0	3.0	1.0	..	....	Deep yellow
14.7	7.0	6.0	..	....	Deep yellow
14.7	9.0	4.0	..	....	Deep yellow
3.0	1.0	1.0	..	....	Light red
10.0	1.0	4.0	..	....	Light red
1.0	..	1.0	..	....	Bright red
1.0	..	2.0	..	....	Bright red
30.0	3.0	..	2.0	....	Gray
4.0	..	..	1.0	....	Gray
29.0	11.0	..		....	Gray
1 to 3	..	..	1.0	....	Blue

Color.	Gold.	Silver.	Copper.	Iron.	Platinum.	Cadmium.
White	..	100	..	..	..	..
White	..	..	..	..	100	..
Gray	85.7	8.6	..	5.7	..	..
Gray	83.3	..	..	16.7	..	..
Gray	72.5	27.5	..	..	..	..
Green	75	25	..	..	..	..
Green	75	16.6	..	..	..	8.4
Green	74.6	11.4	9.7	..	..	4.3
Green	75	12.5	..	..	..	12.5
Pale yellow	91.67	8.33	..	..	..	..
Pale yellow	91.67	..	..	8.33	..	..
Very pale.	50	50	..	..	..	..
Yellow ...	100	..	..	..	..	..
Deep yellow	90	..	10	..	..	..
Deep yellow	53	25	22	..	..	..
Red	75	..	25	..	..	..
Dark red..	50	..	50	..	..	..
Dark red..	25	..	75	..	..	..
Blue	75	..	..	25	..	..
Blue	66.7	..	..	33.3	..	..
Jap'ese blue gold ...	1 to 10	..	99 to 90	..	..	..

3.—Blue Gold.—Gold, 750 parts; iron, 250 parts. Prepared by dipping iron wire into molten gold, then casting, hammering, and passing through a draw plate.

4.—Gray Gold Alloy.—Gold, 94 parts; iron, 6 parts; or 95.5 parts of gold united with 4.5 parts of iron.

5.—Green.—To make green gold, melt together 19 gr. of pure gold and 5 gr. of pure silver. The metal thus prepared has a beautiful green shade.

Copper-Gold Alloy.—Copper, 800 parts; platinum, 28 parts; tungstic acid, 20 parts; melted in a crucible, under a flux, and the melted mass poured out into alkaline water, so as to granulate it. It is then melted together with 170 parts of gold.

Enameling Gold.—1.– Fine gold, 1 oz.; fine silver, 1 dwt. 12 gr.; fine copper, 2 dwts. 12 gr.

2.—Fine gold, 1 oz.; fine silver, 9 dwts. 12 gr.; fine copper, 7 dwts. 12 gr.

Feuille Morte (dead leaf).—Gold, 700 parts; silver, 300 parts.

Fine Gold.—Gold, 750 parts; silver, 250 parts.

Grain, Gold, Cupelled.—Gold, 1 part; silver, 3 parts; melted together, and poured in a small stream into water, the silver being afterward dissolved out by digestion in boiling nitric acid, and the grains, after being well washed in water, heated to redness in a crucible or cupel. Used to make preparations of gold.

Horology, Alloy for.—1.—The following alloy, suited for the sockets of pivots of watches, was invented by Mr. Bennett. It consists of gold, 31 parts; silver, 19 parts; copper, 39 parts; palladium, 11 parts. He states that this alloy melts at a lower temperature than gold, and is harder than hammered iron. It has a reddish brown color, is as fine-grained as steel, and works as easily as brass, but its friction is much slighter than on ordinary pivots. Its most valuable property is that the oil it absorbs is not decomposed, but remains pure in a fluid state. It has still greater advantages over sockets of fine stone, as it is not apt to break, is susceptible of a high polish, and is less costly than hard stone.

2.—Jewelers' Gold.—This term is applied to alloys of gold used for trinkets and inferior articles of jewelry, ranging from 3 or 4 carats fine upward. The lowest alloy of this class is formed of copper, 16 parts; silver, 1 to 1½ parts; gold, 2 to 3 parts; melted together.

3.—Jewelry Gold.—Gold, 38.85; silver, 5.7; copper, 10.20.

Non-Magnetic Alloy.—This is used in

some of the Swiss watches to take the place of steel in the hair springs. It is composed of equal parts of gold and palladium, copper about 15% of the whole, and a trace of rhodium and manganese are added; this may vary from 1-10th of 1% to 5% of each. The copper and manganese are first added.

Nurnberg Gold.—(See *Aluminum and Gold.*)

Palladium.—1.—An alloy of palladium 20 parts, gold 80, is white, hard as steel, unchangeable in the air, and can, like the other alloys of palladium, be used for dental purposes.

2.—Alloys of gold, copper, silver, and palladium have a brownish red color and are as hard as iron. They are sometimes (although rarely) used for the bearings for the pivots of the wheels of fine watches, as they cause less friction than the jewels commonly used for the purpose, and do not rust in the air. The composition used in the Swiss and English watch factories consists usually of gold 18 parts, copper 13, silver 11, and palladium 6.

Red Gold.—Gold, 750 parts; copper, 250 parts.

Ring Gold.—Coin gold, 49.6 parts; silver, 12.3 parts; refined copper, 23.6 parts.

Shakdo.—This is a famous Japanese alloy. It is composed of copper and gold, the proportions of the latter being variable, being from 2 to 8%.

Talmi Gold.—The name of talmi gold was first applied to articles of jewelry, chains, earrings, bracelets, etc., brought from Paris, and distinguished by beautiful workmanship, a low price, and great durability. Later, when this alloy had acquired a considerable reputation, articles were introduced under the same name, but really made of other metals, and which retained their beautiful gold color only as long as they were not used. The fine varieties of talmi gold are manufactured from brass, copper, or tombac, covered with a thin plate of gold, combined with the base by rolling, under strong pressure. The plates are then rolled out by passing through rollers and the coating not only acquires considerable density, but adheres so closely to the base that the metal will keep its beautiful appearance for years. Of late, many articles of talmi gold are brought into the market whose gold coating is produced by electroplating and is in many cases so thin that hard rubbing will bring through the color of the base. Such articles, of course, are not durable. In genuine talmi gold, the coating, even though it may be thin, adheres very closely to the base, for the reason that the two metals are actually joined by the rolling, and also because alloyed gold is always used, which is much harder than pure gold. The pure gold of electroplating is very soft. The composition of some varieties of talmi gold are here given. It will be seen that the content of gold varies greatly, and the durability of the alloy will, of course, correspond to this. The alloys I, II and III are genuine Paris talmi gold; IV, V and VI are electroplated imitations; and VII is an alloy of a wrong composition, to which the gold does not adhere firmly:

	I.	II.	III.	IV.	V.	VI.	VII.
Copper	89.88	90.79	90.00	90.69	87.48	93.46	86.4
Copper	....	....	....	88.16	83.13	84.55	...
Zinc	9.32	8.33	8.9	88.97	12.44	6.60	12.2
Zinc	....	....	....	11.42	16.97	15.79	...
Tin	....	....	....	....	....	....	1.1
Iron	....	....	....	....	....	....	0.3
Gold	1.03	0.97	0.91	0.5	0.3	0.05	...

White Gold, Electrum.—Gold whitened by addition of silver.

Yellow Gold, Antique.—Pure gold.

Imitation Gold Alloys.

1.—Gold Dutch, Mannheim gold, mosaic gold, ormolu, pinchbeck, Prince's metal, red brass similor, tombac. These names are applied to several varieties of fine gold-colored brass, differing slightly in tint, and in the proportions of copper and zinc. At the celebrated works of Hegermuhl, near Potsdam, the proportions, copper 11 parts to zinc 2 parts, are employed to produce a metal which is afterward rolled into sheets for the purpose of making Dutch leaf gold. This alloy has a very rich, deep gold color. Its malleability is so remarkable that it may be beaten out into leaves not exceeding 1-52900 inch in thickness.

2.—The imitation gold alloys of different shades of yellow, dark, pale, or greenish, are extensively used for cheap gold-colored coatings. The principal places where this special industry is carried on are Vienna, Nuremberg, and Furth, and it is usually pursued in connection with the manufacture of bronze powder. The composition of these alloys varies from 77 to 85 parts of copper and 23 to 15 parts of zinc.

The metals are melted in graphite crucibles, and kept fluid for some time, in order that the alloy may become perfectly uniform. It is then cast into semi-circular ingots about 23½ inches long and ¾ of an inch in diameter. These ingots are rolled cold into strips about the thickness of ordinary writing paper. Each strip is folded together so as to form a package about 23½ inches long. This is beaten under a hammer set in motion by a motor, into a ribbon about 3¾ inches wide. The very thin strips obtained in this way are cut up into pieces, which are again hammered until they begin to tear at the edges, about one thousand of them being placed together for this operation. They are then cut into square leaves, which are placed between parchment leaves and beaten under a rapidly moving hammer until they are about 5¾ inches square. Each of the leaves is now cut into four squares of equal size, which are again beaten between parchment leaves, in the same manner as genuine gold leaf, except that the process is not usually carried so far, inasmuch as this would entail too much labor and expense for a cheap material. The beaten metal is placed in books of tissue paper, which has previously been lightly rubbed with colcothar, to prevent the leaf metal from adhering. The beautiful color of leaf metal may be preserved for some time by a coating of thin varnish, colorless or pale yellow. By adding a small quantity of a pure color—aniline colors being especially good—the color of the leaf metal may be changed to red, green, violet, etc.

3.—An alloy used as a substitute for gold and said to be non-oxidizable was found by the inventor to contain: copper 94.8, zinc 2.8, lead 0.67 and iron 1.34 per cent. The inventor recommends to dip the articles in dilute nitric acid, then to swill and dry, then to polish; and claims that they will keep their color for a long time.

4.—The following recipes for metals resembling gold are said to produce a metal which will so nearly approximate the genuine as to almost defy detection without a resort to thorough tests: Fuse, together with saltpeter, sal ammoniac and powdered charcoal, 4 parts platinum, 2½ parts pure copper, 1 part pure zinc, 2 parts block tin, and 1½ parts pure lead. Another good receipt calls for 2 parts platinum, 1 part silver, and 3 parts copper.

5.—The *Western Jeweler* gives the following formula:

Take 100 parts (by weight) of pure copper, 14 parts zinc or tin, 6 parts magnesia, 56 parts sal ammoniac, 18 parts quicklime, 9 parts cream of tartar. Melt the copper, and add gradually the magnesia, sal ammoniac, quicklime, and cream of tartar, each by itself, in the form of powder. Stir the whole for half an hour, and the zinc or tin in small pieces, and stir again till the whole is melted. Cover the crucible, and keep the mixture in a molten condition for 35 minutes. Remove the dross, and pour the metal into molds. It has a fine grain, is malleable, and does not easily tarnish.

6.—Pure copper, 100 parts; zinc, or, preferably, tin, 17 parts; magnesia, 6 parts; sal ammoniac, 3.6 parts; quicklime, 1.8 parts; cream of tartar, 9 parts. The copper is first melted, then the magnesia, sal ammoniac, lime and tartar are added, separately and by degrees, in the form of powder; the whole is now briskly stirred for about half an hour, so as to mix thoroughly; and then the zinc is added in small grains by throwing it on the surface and stirring till it is entirely fused; the crucible is then covered, and the fusion maintained for about 35 minutes. The surface is then skimmed and the alloy is ready for casting. It has a fine grain, is malleable, and takes a splendid polish. Does not corrode readily, and for many purposes is an excellent substitute for gold. When tarnished, its brilliancy can be restored by a little acidulated water.

Gold Bronze.—In the case of articles where a beautiful color is desired at little expense, it would scarcely be practicable to use genuine gold for a coating; and an effort must be made to give the alloy itself a color resembling as closely as possible that of gold. A mixture which meets this requirement remarkably well is composed of copper, 90.5 parts; tin, 6.5 parts; zinc, 3 parts. Its beautiful gold color is not affected by air alone, but is quickly destroyed by exposure to air and water together. To retain the color, therefore, articles made from it may be kept standing in a room, but not exposed to the weather. Under the influence of air and moisture combined they become covered, in the course of time, like all genuine bronzes, with the characteristic green coating known as genuine patina, highly esteemed in bronze articles for its effect in bringing out the beauty of the contours.

Chrysochalk, or Gold Copper.—1.—Chrysochalk is similar in composition to Mannheim gold.

	I.	II.
Copper	90.5	58.68
Zinc	7.9	40.22
Lead	1.6	1.90

In color it resembles gold, but quickly loses its beauty if exposed to the air, on account of the oxidation of the copper. It can, however, be kept bright for a long time by a coating of colorless varnish, which excludes the air and prevents oxidation. Chrysochalk is used for most of the ordinary imitations of gold. Cheap watch chains and jewelry are manufactured from it, and it is widely used by the manufacturers of imitation-bronze ornaments.

2.—Another mixture called chrysochalk, also distinguished by a beautiful gold color, is composed of copper, 95 parts; tin, 5 parts.

Copper and Antimony, Process for Producing Goldlike Alloy from.—This invention, patented in Germany, covers a metallic alloy, to take the place of gold, which, even if exposed for some time to the action of ammoniacal and acid vapors, does not oxidize or lose its gold color. It can be rolled and worked like gold, and has the appearance of genuine gold without containing the slightest admixture of that metal, besides being much cheaper than other precious and semiprecious metals as well as the compounds and alloys used as substitutes for precious metals. The alloy consists of copper and antimony in the approximate ratio of 100 to 6, and is produced by adding to molten copper, as soon as it has reached a certain degree of heat, the said percentage of antimony. When the antimony has likewise melted and entered into intimate union with the copper, some charcoal ashes, magnesium and lime spar are added to the mass when the latter is still in the crucible. Although the action of this material admixture of flux is not entirely explained, the alloy loses thereby a certain porosity otherwise present, and an exceedingly great density of the cast metal is obtained. Same can now be rolled, wrought, hammered, and soldered like gold, and when polished has the appearance of genuine gold, while being considerably firmer than the latter.

Factitious Gold.—1.—Copper, 16 parts; platinum, 7 parts; zinc, 1 part; fused together. This alloy resembles in color gold of 16 carats fine, or two-thirds, and will resist the action of nitric acid, unless very concentrated and boiling.

2.—The alloy has about the color of 9-carat gold: Silver, 2.48%; platinum, 32.02%; copper (by difference), 65.50%. Strong, boiling nitric acid has apparently no action on it, even when left in the acid for some time.

Jewelry, Common.—1.—Refined copper, 3 parts; old Bristol bronze, 1 part; tin, 25 parts for every 100 parts of copper, the tin being replaced by a compound of lead and antimony when a fine polish is needed.

2.—The following forms a fusible, malleable metal, easily worked by a silversmith, resisting oxidation, and capable of being soldered: Copper, 720 parts; nickel, 125 parts; bismuth, 10 parts; zinc, 90 parts; soft iron, 20 parts; tin, 20 parts.

3.—Sauvage has introduced the following alloy: Copper, 58 parts; zinc, 27 parts; nickel, 12 parts; tin, 2 parts; alumina, 0.5 part; bismuth, 0.5 part. The ingredients are fused separately, mixed, and the whole is run down into a homogeneous mass, which is silvery, sonorous, malleable, ductile, tenacious, polishes well. and does not tarnish.

4.—As a silvery-looking alloy, Parker recommends: Copper, 70 parts: manganese, 30 parts; zinc, 20 to 35 parts. Or, if not needing to be subjected to high temperature: Copper, 49 parts; manganese, 21 parts; iron, 5 to 10 parts; zinc, 5 to 10 parts. The solder used for it contains: Copper, 7 parts; manganese, 3 parts; silver, 1 to 2 parts.

5.—Cheap 4-carat gold. Copper, 9 parts; gold, 2 parts; silver, 1 part.

Leaf Brass.—1.—This alloy is also called Dutch gold, or imitation gold leaf. It is made of copper, 77.75 to 84.5 parts; zinc, 15.5 to 22.25 parts. Its color is pale or bright yellow or greenish, according to the proportions of the metals. It has an unusual degree of ductility.

2.—	Deep gold.	Pure gold	Pale gold.
Copper....	84.5	78	76
Zinc.......	15.5	22	14
	Deep gold.	Deep gold.	Gold.
Copper....	91	86	83
Zinc......	9	14	17
	(Reddish)	(Dark yellow)	(Bright yellow)

Mannheim Gold or Similor.—Mannheim gold is composed of copper, zinc and tin, in proportions about as follows:

	I.	II.	III.	IV.
Copper	83.7	89.8	88.9	75
Zinc	9.3	9.9	10.3	25
Tin	7.0	0.6	0.8	..

It has a fine yellow color, and was formerly much used in making buttons and pressed articles resembling gold. Later alloys, however, surpass it in color, and it has fallen somewhat into disuse. One variety of Mannheim gold, so called, contains 1.40 parts of brass (composition, 3 Cu_2 1 Zn) to 10 parts of copper and 0.1 part of zinc.

Mock Gold.—1.—Copper, 16 parts; platinum, 7 parts; zinc, 1 part.

2.—Copper, 100 parts; tin, 17 parts; magnesia, 6 parts; sal ammoniac, 3.6 parts; quicklime, 1.8 parts; bitartrate of potash, 9 parts. The copper is melted first, and the magnesia, ammonia, lime and potash are successively added, in small quantities; finally the tin is introduced in fragments, and the whole fused for 35 minutes.

Mosaic Gold, Chrysorin, Hamilton's Metal.—The above names are applied to an alloy composed, with slight deviations, of 100 parts of copper and 50 to 55 parts of zinc. It has a very beautiful color, closely resembling that of gold, and is distinguished by a very fine grain, which makes it especially suitable for the manufacture of castings which are afterward to be gilded. The best method of obtaining a thoroughly homogeneous mixture of the two metals is to first put into the crucible one-half of the zinc to be used, place the copper upon it, and fuse the mixture under a cover of borax at as low a temperature as possible. Have ready the other half of the zinc, cut into small pieces, and heated almost to melting, and when the contents of the crucible are liquid throw it in, a small portion at a time, stirring constantly to effect as intimate a mixture of the metals as possible.

Orcide or Oroide, French Gold.—The so-called French gold, when polished, so closely resembles genuine gold in color that it can scarcely be distinguished from it. Besides its beautiful color it has the valuable properties of being very ductile and tenacious, so that it can easily be stamped into any desired shape; it also takes a high polish. It is frequently used for the manufacture of spoons, forks, etc., but is unsuitable for this purpose on account of the large amount of copper contained in it, rendering it injurious to health. The directions for preparing this alloy vary greatly. The products of some Paris factories show the following composition:

	I.	II.	III.
Copper	90	80.5	86.21
Zinc	10	14.5	31.52
Tin	..	....	0.48
Iron	..	....	0.24

A special receipt for oreide is the following: Melt 100 parts of copper, and add, with constant stirring, 6 parts of magnesia, 3.6 parts of sal ammoniac, 1.8 parts of lime and 9 parts of crude tartar. Stir again thoroughly, and add 17 parts of granulated zinc, and after mixing it with the copper by vigorous stirring, keep the alloy liquid for one hour. Then carefully remove the cover of froth and pour off the alloy.

Ormolu, Or Moulu.—The French name for this alloy is obviously incorrect, inasmuch as it is not cast gold, but really a gold-colored bronze, related in its composition to that variety known as statuary bronze. It serves manifold purposes in industrial art, being used for statuettes and articles of ornament, as well as for candlesticks, inkstands, etc. An interesting application of it is in the manufacture of articles to be enameled. The enamel is placed in shallow cavities chiseled in the surface of the bronze, and melted by heating the latter. The edges of the cavities separate the different colors of the melted glass, and the articles, after heating, appear coated with the closely adhering enamel. This work is known by the French name of "*email cloissonne.*" Cloisonne articles were first introduced into European countries from China, but at the present day the European work as far surpasses the Chinese as in the case of porcelain.

Real ormolu is in itself of a pure golden yellow color, and therefore requires but little gold for gilding. It is composed of copper, 58.3 parts; tin, 16.7 parts; zinc, 25.3 parts; and is used for the finest bronze articles of luxury.

Pinchbeck.—1.—Pinchbeck was first manufactured in England. Its dark gold color is the best imitation of gold alloyed with copper. Being very ductile, it can easily be rolled out into thin plates, which can be given any desired shape by stamping. It does not readily oxidize, and thus fulfils all the requirements for making cheap jewelry, which is its principal use. It is composed of copper and zinc, or copper, zinc and brass, in the proportions given:

	I.	II.
Copper	88.8	93.6
Zinc	11.2	6.4
or		
Copper	2.0	1.28
Zinc	..	0.7
Brass	1.0	0.7

2.—Copper, 5 lb.; zinc, 1 lb.

Platinor.—This is a name given to certain alloys containing platinum of a golden yellow color, and consisting of platinum, copper, silver, zinc and nickel. An alloy of the color of gold, and said to be quite constant in air, is prepared as follows: Melt 10 parts of silver with 45 parts of copper, then add 18 parts of brass and 9 parts of nickel. The temperature must then be raised to the highest pitch and 18 parts of platinum black added.

Platinum and Copper.—1.—*Golden-Yellow Alloys of.*—Alloys whose composition is such that they resemble pure gold in color are well suited to the manufacture of jewelry and other ornamental articles. They can be prepared for about twice the cost of silver, and are not only much cheaper than gold, and equally beautiful in color, but considerably more durable. The composition of these alloys of platinum and copper, employed in making jewelry, varies exceedingly. A few of the compositions are here given:

	I.	II.	III.	IV.
Platinum	2	20	7	3
Copper	5	..	16	13
Zinc	..	..	1	..
Silver	1	20	..	..
Brass	2	240	..	..
Nickel	1	120	..	..

The alloy numbered IV, called Cooper's gold, is most excellent for manufacturing jewelry, since its color cannot be distinguished from that of 18-carat gold, even by close comparison. It can be drawn out without difficulty to the finest wire, and rolled into very thin sheets.

2.—Other alloys of the same nature are composed as follows:

	I.	II.	III.	IV.
Platinum	15	16	7	6
Copper	10	7	16	23
Zinc	1	1	1	..

The successful preparation of these alloys depends upon one condition, namely, that the metals shall be entirely free from iron. If this is not the case, the alloys will indeed show the requisite color, but will be too hard, and so brittle that they cannot be drawn out into thin sheet or fine wire. It has been found by accurate experiment that a very small percentage of iron is sufficient to lessen the ductility considerably; an 8-1000 part of the weight of the alloy will make it noticeably brittle. The metals used in preparing the alloy must, therefore, be tested beforehand for the presence of iron, and any which contain the slightest trace of it excluded.

Prince's Metal.—A name given to various yellow alloys, varying from 60 to 75% of copper and 40 to 25% of zinc.

Tombac.—1.—An alloy consisting of copper, 16 lb.; tin, 1 lb.; zinc, 1 lb. Red tombac is composed of copper, 10 lb.; zinc, 1 lb.

2.—Copper, 16 lb.; tin, 1 lb.; zinc, 1 lb.

Tournay's Metal.—This alloy is characterized by great ductility, and is much used on this account by the Paris manufacturers of bronze articles, and for the manufacture of imitation jewelry from thin sheets, for pressed buttons, etc. It is composed of copper, 82.54 parts; zinc, 17.46 parts.

Unalterable Alloy (Jacobi).—Copper, 70 to 73%; tin, 2 to 11%; lead, 15 to 20%; zinc, 0.5 to 1%. This alloy possesses a yellowish red tint, and may be used for objects of art, imitation jewelry, etc. When treated with sulphides, chloride of antimony, chloride of arsenic, etc., this alloy becomes coated with a black patina, capable of being polished.

IRON

Ferro-manganese is a variety of metal specially manufactured in a blast furnace from ores rich in oxide of manganese, and is very extensively used in the manufacture of mild steel. When the pig iron contains less than about 20% manganese its fracture shows large crystalline cleavage planes, and it is then termed spiegeleisen. The variety known as ferromanganese is a hard, crystalline body, but the fractured surface does not present the large cleavage planes so characteristic of spiegeleisen. It contains from 20 to 85% of manganese.

Glass Molds, Alloy for Casting.—Iron, 100 parts; nickel, 15 parts.

Sideraphite.—Iron, 63 parts; nickel, 23 parts; tungsten, 4 parts; aluminum, 5 parts; copper, 5 parts.

LEAD

Bullet Metal.—Lead, 98 parts; arsenic, 2 parts. For round shot, the fused metal is dropped from a high elevation in a shot tower into a basin of water; or thrown down a stack of limited height, in which a strong draught of air is produced by a blower.

Calin.—The lining of tea chests is called calin. It is composed of lead, 50 to 60 parts; tin, 8 parts; copper, ½ part; and a small percentage of zinc.

Leading, Hot Alloys for.—Tin, 3 parts; lead, 17 parts.

Magnolia Metal.—Lead, 840 parts; antimony, 7½ parts; tin, 2½ parts; bismuth, ⅛ part; aluminum, ⅛ part; graphite, ⅛ part.

Patent Sheathing for Ships.—(Baron Wetterstedt.)—This consists of lead with from 2 to 8% of antimony. Usually about 3% is used.

1.—*Shot Metal.*—Lead, 1,000 parts; arsenic, 3 parts.

2.—Lead, 97 parts; arsenic, 3 parts.

MANGANESE

Manganese Bronze.—This is a new combination introduced by Mr. P. M. Parsons. Copper and iron unite at high temperatures in various proportions, forming alloys of great hardness, and when the iron is present in certain proportions the tenacity and elasticity of the copper are increased. The same remarks apply to brass and bronze. It should be stated, however, that the above properties are acquired at the expense of ductility and toughness.

The use of ferro-manganese in making manganese bronze is objectionable, owing to the iron introduced, but this objection can be avoided by the adoption of a rich alloy of copper and manganese, now obtainable commercially, by the use of which a very pure series of manganese bronze can readily be produced. One of the best of these, suitable for gun wheels, propellers and mining machinery, had the following composition: Copper, 53%; zinc, 42%; manganese, 3.75%; aluminum, 1.25%. The absence of iron permits the use of the large proportion of zinc without risk of rendering the metal brittle. The addition of the aluminum is necessary with the above alloy, as otherwise it is difficult to obtain sound castings.

Cupro-Manganese.—Copper and manganese unite in various proportions, forming alloys which may be red, like copper, or silvery-white in color, depending upon the amount of manganese present. They possess considerable hardness and tenacity, some are very ductile, and more fusible than ordinary bronze. They are distinguished by the property of soundness when cast into molds, the castings being free from blowholes. The great difficulty in producing alloys containing much manganese is owing to the great affinity that this metal has for oxygen, and the high temperature required for the reduction of the manganese from its oxides, which are used as a source of the metal. This renders the production of homogeneous alloys with a required amount of manganese very difficult.

Pure oxide of manganese is not found in nature, at any rate only in rare cases. The most frequently occurring ore is pyrolusite, generally containing oxides of other metals, which are reduced along with the manganese, and enter into the composition of the alloy. Pyrolusite is used for the manufacture of chlorine gas, and the by-product can be used to obtain oxide of manganese in a comparatively pure form, and this is employed for the production of cupro-manganese, by reducing it in contact with copper. The copper is finely granulated, mixed with charcoal and dry oxide of manganese, in alternate layers, in a plumbago crucible, and the whole covered with a thick layer of charcoal powder. A lid is then placed on to prevent admission of air, the crucible put into a wind furnace, and exposed to the highest temperature of the same for some hours. The oxide is gradually reduced to the metallic state, and alloys with the copper, forming cupro-manganese, which settles to the bottom of the crucible. When the operation is completed the pot is removed from the furnace and the contents vigorously stirred with an iron rod to thoroughly incorporate the ingredients and produce a homogeneous alloy. The metal thus obtained is silver-white in color, resembling German silver.

Cupro-manganese is considerably, altered in composition by repeated remelting, the manganese being so readily oxidized; and as metallic manganese is not a commercial article, the metal cannot be added to make up the loss in the same way as zinc is added to brass. Moreover, the crucible is strongly attacked by oxide of manganese, which has a strong affinity for silica, forming a liquid slag. Alloys containing from 15 to 30% of manganese have a white color, are hard, very tough, and can be forged and rolled.

In making alloys of brass, bronze, or German silver, containing manganese, the cupro-manganese must be rapidly melted under charcoal and added to the alloy, then the whole well mixed, and poured as soon as possible. Varieties of cupro-manganese which are especially valuable for technical purposes are given below:

	I.	II.	III.	IV.
Copper	75	60	65	60
Manganese	25	25	20	20
Zinc	..	15	5	..
Tin	..	..	..	10
Nickel	..	..	10	10

Manganese Alloys.—Cupro-manganese, 6 parts; lead, 9 parts; tin, 48 parts; zinc, 9 parts. Tin, 32 parts; zinc, 7 parts; lead, 7 parts; cupro-manganese, 2 parts.

Cupro-ferro-Manganese.—Mr. Parsons prepares this alloy by mixing a certain proportion of ferro-manganese (an alloy of iron and manganese) with copper, and the product is afterward made into alloys similar to bronze, brass and other copper alloys. The ferro-manganese and the copper are melted in separate crucibles, and the ferro alloy added to the copper. The effect of this combination is similar to that produced by the addition of ferro-manganese to the decarburized iron in the Bessemer converter. The manganese and iron in the metallic state, having a great affinity for oxygen, cleanse the copper of any oxides it may contain, by combining with the oxygen, and rising to the surface, in the form of slag, and thus render the metal dense and homogeneous. A portion of the iron and manganese is utilized in this manner and the remainder becomes permanently combined with the copper, and plays an important part in improving and modifying the quality of the bronze and brass alloys, afterward prepared from the copper thus treated. The effect is greatly to increase their strength, hardness and toughness, the degrees of all of which can be modified at will, according to the quantity of ferro-manganese used and the proportions of iron and manganese it contains. An alloy of 40 parts of copper and 60 parts of ferro-manganese, with a suitable quantity of some appropriate flux, produces a metal of such tenacity that it surpasses the best steel armor plates. The melted mixture is cast in blocks, and is perfectly malleable. To obtain a white metal that can be rolled out in sheets, the above alloy is melted again, and 20 or 25% of zinc or white metal added, which imparts to it the desired quality. A plate of the first named alloy, 2 in. thick, was found, by experiment, to offer more resistance to a cannon ball than a steel armor plate of the same thickness. This new kind of "white bronze" is not to be confounded with the alloy used under the same name for gravestones and monuments, and which consists principally of zinc.

Experiments have been made in Paris with a new alloy having a white color, yet containing no nickel. It is said to be very strong and melleable. It is made of copper and ferro-manganese, the proportions being varied according to the purpose for which the alloy is to be employed.

Manganese German Silver.—1.—" Manganese German silver" was made from copper, 70 parts; manganese, 15 parts; zinc, 15 parts. But as this alloy proved rather brittle in the rollers, the proportions were altered to copper, 80 parts; manganese, 15 parts; zinc, 5 parts; when a beautiful white and ductile metal was obtained, which would take a high polish.

2.—An excellent substitute for German silver can be obtained, having the following composition: Copper, 67.25%; manganese, 18.50%; zinc, 13%; aluminum, 1.25%. The metal thus produced is said to be as strong as German silver, and makes better castings, while it is less liable to corrosion. Its electrical resistance is four times as great as that of the older alloy.

Manganese Steel.—Copper, 80%; manganese, 15%; zinc, 5%.

Manganese and Tin.—Manganese and tin combine as readily as manganese and copper. Tin, however, shows, as in ordinary bronzes, a tendency to separate itself in the middle of thick castings from the other alloys, because it remains longest in a fluid condition, and under the process of solidification it seems to get squeezed out of those parts of a casting which retain the heat longest.

Manganese-Tin Bronze.—An important series of experiments made at Isabelle-Hutte have shown that the strongest "manganese-tin bronze" is obtained by alloying 85% of copper with 6% of tin, 5% of zinc and 5% of manganese copper, so that the cooled product retains something above 1% of manganese. The best mode of procedure is first to melt the copper in a crucible, then to add, successively, tin and zinc, but manganese copper only at the last moment, when the metals are well stirred up with a rod made from gas-retort graphite; a reaction upon the oxides of the metallic bath is clearly noticed, as it begins to boil and emit sparks after the addition of manganese, of which a portion is carried into the slag.

"*Manganese Tin and Zinc Bronzes*" are obtained by adding to an alloy of copper, tin and zinc, a certain quantity of "manganese copper," viz.: the combination of 70 parts of copper with 30 parts of manganese, as above described, by which an increase of at least 9% of strength is obtained over the ordinary alloy. This seems to be greatly due, as in the case of the refined, tough copper, to a chemical action of the manganese; for all ordinary bronzes contain more or less of copper and tin oxides, which are reduced to metal by the action of the manganese. An addition of manganese seems, however, to have also physically a strengthening effect, and an addition of 3 to 6% of manganese copper has been experimentally found to suit the purpose best.

PLATINUM

Platinum Bronze.—Several alloys of platinum, of a comparatively inexpensive nature, have been manufactured under the above name, and it has been claimed for them that they are indifferent to the action of air and water. They admit of a high polish, and retain their luster for a long time. The following are some of their compositions and uses: For table utensils, nickel, 90%; platinum, 0.9%; tin, 9%. For bells, nickel, 81.5%; platinum, 0.8%; tin, 16%; silver, 1.7%. For articles of luxury, nickel, 86.5%; platinum, 0.5%; tin, 13%. For tubes for telescopes, etc., nickel, 71%; platinum, 14.5%; tin, 14.5%. For ornaments, nickel, 31.6%; platinum, 3.2%; brass, 65.2%.

Cooper's Pen Metal.—This alloy is especially well adapted to the manufacture of pens, on account of its great hardness, elasticity, and power of resistance to atmospheric influences, and would certainly have superseded steel if it were possible to produce it more cheaply than is the case. The compositions most frequently used for pen metal are copper, 1 part; platinum, 4 parts; silver, 3 parts; or, copper, 12 parts; platinum, 50 parts; silver, 36 parts. Pens have been manufactured consisting of several sections, each of a different alloy, suited to the special purpose of the part. Thus, for instance, the sides of the pen are made of the elastic composition just described; the upper part is of an alloy of silver and platinum, and the point is made either of tiny cut rubies, or of an extremely hard alloy of osmium and iridium, joined to the body of the pen by melting in the flame of the oxyhydrogen, blowpipe. The price of such pens, made of expensive materials, and at the cost of great labor, is, of course, exceedingly high, but their excellent qualities repay the extra expense. They are not in the least affected by any kind of ink, are most durable, and can be used constantly for years without showing any signs of wear. The great hardness and resistance to the atmosphere of Cooper's alloys make them very suitable for manufacturing mathematical instruments where great precision is required. It can scarcely be calculated how long a chronometer, for instance, whose wheels are constructed of this alloy, will run before showing any irregularity due to wear. In the construction of such instruments the price of the material is not to be taken into account, since the cost of the labor in their manufacture so far exceeds this.

Gold Alloys, Platinum and.—1.—Small quantities of platinum change the characteristics of gold in a considerable degree. With a very small percentage the color is noticeably lighter than that of pure gold, and the alloys are extremely elastic; alloys containing more than 20% of platinum, however, almost entirely lose their elasticity. The melting point of the platinum-gold alloy is very high, and alloys containing 70% of platinum can be fused only in the flame of oxyhydrogen gas, like platinum itself. Alloys with a smaller percentage of platinum can be prepared in furnaces, but require the strongest white heat. In order to avoid the chance of an imperfect alloy from too low a temperature, it is always safer to fuse them with the oxyhydrogen flame. The alloys of platinum and gold have a somewhat limited application; those which contain from 5 to 10% of platinum are used for sheet and wire in the manufacture of artificial teeth.

2.—For Dental Purposes.

	I.	II.	III.
Platinum	6	14	10
Gold	2	4	6
Silver	1	6	..
Palladium	..	..	8

3.—Mirrors.—Alloy of gold and platinum for coating. A solution of 500 grams of spongy platinum in 100 c. c. of a mixture of equal parts of hydrochloric and nitric acids is evaporated to dryness, and the dry residue, after powdering, digested with 2,000 grams of lavender essence, 100 grams of turpentine, and 25 grams of sulphureted turpentine rosins. The gold, 30 grams, is transformed into chloride, and this is dissolved in 1,000 c. c. of a mixture of equal parts of ether and water. The mixture is well shaken, and ethereal solution added to the platinum and left to evaporate spontaneously, The mixture receives afterward a charge of 50 grams of litharge and a like quantity of lead borate, and 100 grams of lavender oil are added to it, when it will be ready for coating the mirror, which has to be exposed to red heat until the composition is burnt in.

Iridio-Platinum.—Platinum is capable of being united to most other metals, the alloys being, as a rule, more fusible than platinum itself. It occurs in nature in combination with a rare metal called *iridium*, with which it is often alloyed; the resulting metal is called *iridio-platinum*, and though still malleable, is harder than platinum, and unattacked by aqua regia; it is also much less readily fusible than platinum itself. Silver is hardened, but rendered brittle, by being alloyed with very small quantities of platinum.

Platinum and Nickel.—According to Lampadius, equal parts of nickel and platinum unite to form a pale yellowish-white alloy, perfectly malleable, susceptible of a high polish, equal to copper in fusibility and to nickel in magnetic power.

Platinum and Silver.—An addition of platinum to silver makes it harder, but also more brittle, and changes the white color to gray; an alloy which contains only a very small percentage of platinum is noticeably darker in color than pure silver. Such alloys are prepared under the name of *"platine au titre,"* containing between 17 and 35% of platinum. They are almost exclusively employed for dental purposes.

Watch Manufacturers, Alloys for.—Some very tenacious and hard alloys for making the parts of watches which are not sensitive to magnetism are as follows:

	I.	II.	III.	IV.	V.	VI.	VII.
Platinum..	62.75	62.75	62.75	54.32	0.5	0.5	...
Copper	18.00	16.20	16.20	16.00	18.5	18.5	25.0
Nickel	18.00	18.00	16.50	24.70	...	2.0	1.0
Cadmium,	1.25	1.25	1.25	1.25	...	...	...
Cobalt	....	....	1.50	1.96	...	...	...
Tungsten	....	1.80	1.80	1.77	...	...	...
Palladium..	....	....	....	....	72.0	72.0	70.0
Silver..	....	....	....	....	6.5	7.0	4.0
Rhodium..	....	....	....	....	1.0	...	...
Gold...	....	....	....	....	1.5	...	...

SILVER

Silver and Aluminum.—1.—Alloys of these metals were made some years ago, and it was thought that valuable metals of a white color, and unaffected by the atmosphere, would be obtained, which would make them superior to ordinary silver-copper alloys; but these great expectations have not as yet been realized. Aluminum hardens silver, and the alloys admit of a high polish.

2.—Tiers-Argent.—This alloy is chiefly prepared in Paris, and used for the manufacture of various utensils. As indicated by its name (one-third silver), it consists of 33.33 parts of silver and 66.66 parts of aluminum. Its advantages over silver consist in its lower price and greater hardness; it can also be stamped and engraved more easily than the alloys of copper and silver.

Silver and Antimony.—Alloys of these metals may be obtained in all proportions by direct fusion. They are hard, brittle, and gray or white in color. The whiteness decreases with the proportion of antimony. The alloys are very fusible, and wholly decomposed by cupellation or by fusion with niter, pure silver remaining. Mr. R. Smith has prepared the following alloys:

	I.	II.	III.
Silver	72.65	77.98	84.16
Antimony	27.35	22.02	15.84

corresponding to the formulae $3Ag + Sb$, $4Ag + Sb$, and $6Ag + Sb$, respectively. The silver was melted first, under a layer of charcoal, and the antimony then added. No. 1 was hard, crystalline, and bluish white; No. II was similar to No. I, but grayish white; No. III was hard, granular, and grayish white. The specific gravities of 48 silver-antimony alloys containing 50% of silver and upward, have been determined by Cooke, of Harvard, who found that the densities were above the mean densities of the constituents, the maximum being reached in the alloy containing 26.6% of antimony. Cooke also found that the crystallization of the alloys becomes marked as the same composition is approached.

Silver and Arsenic.—These metals are capable of uniting in several proportions, forming hard, gray, brittle, and readily fusible alloys. Gehlen produced an alloy containing 16% of arsenic, which is compact, brittle, steel-gray, and fine-grained. Berthier describes an alloy of 14.8% of arsenic as dull gray, brittle, and crystalline; by burnishing, it acquires the luster and color of silver; it is very fusible, and not decomposed on heating. Guettier describes an alloy containing 14% of arsenic, formerly used for table ware. Mr. R. Smith prepared a hard and brittle, though somewhat tough alloy, which became white and lustrous on burnishing. It contained 18.54% of arsenic, and corresponded to the formula Ag_8As. Silver-arsenic alloys may be prepared by direct fusion of the constituent metals, or by melting a mixture of silver, arsenious acid and black flux. Alloys containing small quantities of arsenic were formerly used in England in the manufacture of table ware. They are not, however, suitable for this purpose, on account of the poisonous character of the arsenic. They are composed usually of 49 parts of silver, 49 parts of copper and 2 parts of arsenic.

Silver and Bismuth.—Alloys of these metals are hard, easily fusible, brittle, and lamellar in structure. The color of the 50% silver alloy is the same as that of bismuth. An alloy containing 33.33% of silver is said to be steel gray and to expand on solidification. Schneider states that when impure bismuth, containing sulphur, arsenic, iron nickel and silver, is fused, and poured upon a cold plate, the globules of metal which are thrown up during solidification of the mass contain at least 99.5% of bismuth, and of the heavy metals only silver is found in the bismuth. Even a very small quantity of bismuth renders silver ingots very brittle, and if dropped on the floor will break into several pieces. The metal is then very crystalline, each crystal itself being ductile, while the mass of the ingot is very brittle. This brittleness is probably due to the presence of a fusible eutectic which surrounds each of the crystals.

Silver, Copper, Nickel and Zinc.—These alloys, from the metals contained in them, may be characterized as argentan or German silver with a percentage of silver. They have been used for making small coins, as in the older coins of Switzerland. Being quite hard, they have the advantage of wearing well, but soon lose their beautiful white color and take on a disagreeable shade of yellow, like poor brass. The silver contained in them can only be regained by a laborious process, which is a great drawback to their use in coinage.

1.—The composition of the Swiss fractional coins is as follows:

	20 centimes.	10 centimes.	5 centimes.
Silver	15	10	5
Copper	50	55	60
Nickel	25	25	25
Zinc	10	10	10

2.—Argent-Ruolz.—The articles which are manufactured by the Paris firm of Ruolz, under the name of Ruolz silver, or Argent Francais, resemble pure silver perfectly in appearance, but differ from the latter in greater hardness and a much lower price. According to the quality of the object, various alloys are employed in the factories of Ruolz silver. We give below the composition of some of the alloys as produced in the French factories:

	I.	II.	III.
Silver	33	40	20
Copper	37-42	30-40	45-55
Nickel	25-30	20-30	25-35

3.—Silver and Copper Alloys.

Name.	Silver. oz.	Silver. dwt.	Silver. gr.	Copper. oz.	Copper. dwt.	Copper. gr.	Nickel. oz.	Nickel. dwt.	Nickel. gr.	Spelter (Zinc). oz.	Spelter (Zinc). dwt.	Spelter (Zinc). gr.
0. Filigree silver		Pure		0	0	0	0	0	0	0	0	0
1. Standard, Hall	0	19	6	0	0	18	0	0	0	0	0	0
2. Standard, coin	0	18	12	0	1	12	0	0	0	0	0	0
3. Silver alloy	0	18	0	0	2	0	0	0	0	0	0	0
4. Silver alloy	0	16	0	0	4	0	0	0	0	0	0	0
5. Silver alloy	0	15	0	0	5	0	0	0	0	1	0	0
6. Silver alloy	0	14	0	0	6	0	0	0	0	0	0	0
7. Silver alloy	0	13	12	0	6	12	0	0	0	0	0	0
8. Silver alloy	0	13	0	0	7	0	0	0	0	0	0	0
9. Silver alloy	0	12	12	0	7	12	0	0	0	0	0	0
10. Silver alloy	0	12	0	0	8	0	0	0	0	0	0	0
11. Common silver	1	0	0	0	17	0	0	13	0	0	0	0
12. Common silver	1	0	0	0	16	0	0	10	12	0	3	12
13. Common silver	1	0	0	1	2	0	0	15	0	0	0	0

4.—Sterling silver. Fine silver, 5 oz. 11 dwt.; fine copper, 9 dwt.

5.—Equal to sterling-fine silver, 1 oz.; fine copper, 1 dwt. 12 gr.

6.—Copper, Silver and Cadmium.—Cadmium, added to silver alloys, gives great flexibility and ductility, without affecting the white color; these properties are valuable in the manufacture of silver-plated ware and wire. The proportions of the metals vary in these alloys. Some of the most important varieties are given below.

	I.	II.	III.	IV.	V.	VI.	VII.
Silver	980	950	900	860	666	667	500
Copper	15	15	18	20	25	50	50
Cadmium	5	35	82	180	309	284	450

In preparing these alloys, the great volatility of cadmium must be taken into account. It is customary to prepare first the alloy of silver and copper, and add the cadmium, which, as in the case of the alloys of silver and zinc, must be wrapped in paper. After putting it in, the mass is quickly stirred, and the alloy poured immediately into the molds. This is the surest way to prevent the volatilization of the cadmium.

7.—Chinese Silver.—Copper, 58%; zinc, 17.5%; nickel, 11.5%; cobalt, 11%; silver, 2%.

8.—Gray Silver (Japanese Silver).—An alloy is prepared in Japan which consists of equal parts of copper and silver, and which is given a beautiful gray color by boiling it in a solution of alum to which copper sulphate and verdigris are added. The so-called "mokum," also a Japanese alloy, is prepared by placing thin plates of gold, silver, copper, and the alloy just described, over each other and stretching them under the hammer. The cross-sections of the thin plates obtained in this way show the colors of the different metals, which gives them a peculiar striped appearance. Mokum is principally used for decorations upon gold and silver articles.

9.—Mousset's Silver Alloy.—Copper, 59.06%; silver, 27.56%; zinc, 9.57%; nickel, 3.42%. This alloy is yellowish, with a reddish tinge, but white on the fractured surface. It ranks next after Argent-Ruolz, which also contains sometimes certain quantities of zinc, and in this case may be classed together with the alloy just described. The following alloys can be rolled into sheet or drawn into wire:

	I.	II.	III.
Silver	33.3	34	40.0
Copper	41.8	42	44.6
Nickel	8.6	8	4.6
Zinc	16.3	16	10.8

10.—Niello. This consists of silver, 9 parts; copper, 1 part; lead, 1 part; bismuth, 1 part; which are melted together, and saturated with sulphur. This mixture produces the gorgeous blue which has often been erroneously spoken of as steel blue.

Silver and Iron.—These metals do not alloy well together. Messrs. Stoddard and Faraday made some experiments with silver in steel, and concluded that 1-300 of silver corresponds to the best mixture. These alloys do not appear to present any practical interest.

Silver and Lead.—Alloys of these metals are of little interest from a commercial point of view. The metals readily unite in all proportions. A very small amount of lead is sufficient to diminish the malleability and ductility of silver. Molten lead dissolves silver just as mercury does, and homogeneous mixtures are obtained only while the metals are liquid. Levol has investigated this subject, and his results are tabulated below:

	Atomic formula.	Silver per 1000 of alloy. Calculated.	Silver per 1000 of alloy. Found.	Variations in the ingot.
I	$Ag_{20}Pb$	912.5	914.0	7.5
II	$Ag_{15}Pb$	862.0	863.0	14.5
III	$Ag_{10}Pb$	839.1	840.5	23.5
IV	$Ag_4\,Pb$	675.9	676.5	49.5
V	$Ag_2\,Pb$	510.5	516.6	66.5
VI	$Ag\;Pb$	342.8	347.5	11.0
VII	$Ag_2\,Pb_3$	258.0	262.0	13.0
VIII	$Ag\;Pb_2$	206.8	206.0	6.5
IX	$Ag\;Pb_5$	94.4	....	19.5
X	$Ag_2\,Pb_{15}$	65.0	67.25	7.5
XI	$Ag\;Pb_{10}$	49.4	46.00	2.5
XII	$Ag\;Pb_{50}$	10.3	9.75	.25

I. Grayish white, but little malleable, and contracts during solidification.

II. Grayish white, resembles platinum in color and grain, contracts during solidification, and changes rapidly in moist air.

III. Grayish white; contracts strongly during solidification; heated in air, it assumes a beautiful violet-blue tint.

IV. Alloy tolerably malleable, but has only feeble tenacity, and melts near cherry-red heat; it is bluish gray in color, and quickly oxidizes in moist air.

V. Is much more like lead than silver, soft, and tolerably malleable and ductile.

The others require no special comments.

Silver and Nickel.—Berthier described an alloy of these metals containing 13.5% nickel which was white, and capable of a high polish; it rolled well, and was very tough. There appears to be very little known concerning alloys of these two metals alone.

Silver and Palladium Alloys.—Silver, 1 part; palladium, 8 to 10 parts. Used by dentists.

Silver and Tin.—1.—A very small quantity of tin renders silver brittle. Alloys of tin and silver, according to Guettier, are harsh, very hard, and brittle. An alloy of 80% tin is nearly as hard as bronze. An alloy of 52% tin is somewhat malleable. These alloys are very easily oxidized. They have a specific gravity less than the mean of the constituents. Tin may be removed from silver by fusion with bichloride of mercury (corrosive sublimate), leaving the silver pure. Dentists use an alloy of 60 parts silver and 40 parts tin, in admixture with mercury, for stopping teeth.

2.—Dental Alloys.—(a) Tin, 91.63 parts; silver, 3.82 parts; copper, 4.4 parts. (b) Tin, 36.78 parts; silver, 48.32 parts; gold, 14.72 parts.

Silver and Zinc.—Silver and zinc have great affinity for each other, and alloys of these two metals are, therefore, easily made. The required quantity of zinc, wrapped in paper, is thrown into the melted and strongly heated silver, the mass is thoroughly stirred with an iron rod, and at once poured out into molds. Alloys of silver and zinc can be obtained which are both ductile and flexible. An alloy consisting of 2 parts of zinc and 1 part of silver closely resembles silver in color, and is quite ductile. With a larger proportion of zinc the alloys become brittle. In preparing the alloy, a somewhat larger quantity of zinc must be taken than the finished alloy is intended to contain, as a small amount always volatilizes. Berthier prepared an alloy containing 80% of silver, which he states was rolled into very thin leaf; it was rigid, elastic, very tenacious, and tough. Mr. G. H. Godfrey prepared the following alloys by pouring molten zinc into molten silver:

	I.	II.	III.	IV.
Silver	8.16	22.47	49.72	67.58
Zinc	91.84	77.53	50.28	32.42

I. The surface was bluish gray. The metal was hard, easily frangible, and easily scratched with a knife. Its fracture was bluish gray, finely granular, and feebly lustrous.

II. The surface was bluish gray. The metal was harder than No. 1, easily frangible, but less easily scratched. Its fracture was bluish gray, bright, and fibrocolumnar.

III. The surface was copper red after solidification. The metal was hard, brittle, and easily pulverized. The broken surface, when fractured cold, was white and very bright, and somewhat columnar.

IV. The surface had a faint reddish-yellow tint. The metal was hard and easily frangible; its fracture white and very bright, but it soon tarnished; it was columnar in structure.

An alloy of 2 parts by weight of zinc and 1 part of silver is said to be ductile, finely granular, and nearly as white as silver.

Silver-zinc alloys have been proposed for coinage purposes. Piligot prepared alloys containing 5, 10 and 20 % of zinc, respectively. They were white, with a tinge of yellow. The coins were elastic and sonorous. These alloys are not so readily blackened by sulphuretted hydrogen as silver-copper alloys.

Silver Substitutes.—1.—A writer gives the constituents of a hard alloy which has been found very useful for the spacing levers of typewriters. The metal now generally used for this purpose by the various typewriter companies is "aluminum silver," or "silver metal." The proportions are given as follows: Copper,

57%; nickel, 20%; zinc, 20%; aluminum, 3%. This alloy, when used on typewriting machines, is nickel-plated, for the sake of the first appearance; but so far as corrosion is concerned, nickeling is unnecessary. In regard to its other qualities, they are of a character that recommends the alloy for many purposes. It is stiff and strong and cannot be bent to any extent without breaking, especially if the percentage of aluminum is increased to 3.5%; it casts free from pinholes and blowholes. The liquid metal completely fills the mold, giving sharp, clean castings, true to pattern; its cost is not greater than brass; its color is silver white, and its hardness makes it susceptible of a high polish.

2.—Iron, 65 parts; tungsten, 4 parts; melted together and granulated. Also nickel, 23 parts; aluminum, 5 parts; copper, 5 parts; in a separate crucible, to which is added a piece of sodium, in order to prevent oxidation. The two granulated alloys are then melted together. Both alloys resist the action of sulphuretted hydrogen.

3.—Copper, 71 oz.; zinc, 7 oz.; nickel, 16½ oz.; iron, 1¼ oz.; cobalt (oxide), 1¾ oz.; tin, 2½ oz. First fuse the zinc with 12 parts of the copper; then fuse the nickel with its own weight of the zinc alloy in a good black-lead crucible, and the iron, the remainder of the copper, and the oxide of cobalt mixed with charcoal. Cover the mass with charcoal, lute, and expose to a high heat. When properly fused, allow the heat to subside, and add the remainder of the copper-zinc alloy when the temperature is just sufficient to fuse it. Remove the crucible from the fire, and stir its contents well with a hazel stick. Wrap the tin in several thicknesses of dry paper, drop it into the alloy, stir for a moment, and run into the molds. When cold it is ready to be wrought like silver, which it resembles in every respect. The zinc is nearly all volatilized during the process of fusion.

4. Aluminum Silver.—The following alloy takes a high silver polish, and exhibits a beautiful silver color: Copper, 70 parts; nickel, 23 parts; aluminum, 7 parts.

5. Sterlin.—A white metal resembling silver has found its way on the market under the name of sterlin, which has been found to contain 68.52% of copper, 12.84% of zinc, 17.88% of nickel, 0.76% of iron, and traces of lead. Silver and manganese were absent. Manganese is very useful for introducing iron into such

alloys. If, says Sperry, an alloy consisting of 4 parts of iron and 1 part of manganese is smelted together with copper and nickel, the iron combines homogeneously with the latter, and an alloy free from hard lumps is formed, while the manganese disappears entirely after from one to four meltings.

6.—

Table of White Alloys

Description.	Silver.	Nickel. dwts.	Brass. lb.	Zinc. dwts.	Tin. lb.	Lead. lb.	Copper. lb.	Antimony. lb.	Bismuth. lb.
Nickel, or German silver	...	3.0	....	16.0	..	...	1.0	...	...
White copper of China	...	15.0	....	13.0	..		1.0	...	...
Queen's metal	...	....	....	..	9.0	2.0	...	1.0	2.0
				lb.					
Britannia metal	...	....	1.0	...	49.0	...	1.0	3.5	...
White button metal	...	....	16.0	2.0	1.0	...	...	...	...
Solder for bell metal	...	....	2.0	....	1.5	...	1.0	...	...
Solder for brass	...	....	1.0	....	0.6		0.15	...	...
Solder for tin	...	....	....	....	1.0	0.5	...	...	...
Solder for silver	1.0	....	0.5	....	....	...	...	...	...
Solder for silver	1.0	....	0.3	....	....	...	...	...	...
Solder for silver	4.0	....	....	....	....	...	1.0	...	...
Solder for Mokume	1.0	....	0.15	....	....	...	...	...	...
French coin	835.0	....	....	....	....	...	165.0	...	...
M. Piligot's coin alloy	950.0	....	....	50.0	....	...	...	...	...
M. Piligot's coin alloy	900.0	....	....	100.0	....	...	...	...	...
M. Piligot's coin alloy	800.0	....	....	200.0	....	...	...	...	...
M. Piligot's coin alloy	900.0	....	....	50.0	....	...	50.0	...	...
M. Piligot's coin alloy	800.0	....	....	100.0	....	...	100.0	...	...
M. Piligot's coin alloy	835.0	....	....	72.0	....	...	93.0	...	...
Gin shi bu ichi	100.0	....	....	.	....	...	30 to 50	...	...

TIN

Algiers Metal.

This alloy cannot properly be classed with bell metal, as its composition is entirely different. It is made of copper, 5 parts; tin, 94.5 parts; antimony, 0.5 part. The antimony is probably used only to give greater hardness. Algiers metal is nearly pure white in color, and takes a fine polish.

Argentin.

Tin, 85.5%; antimony, 14.5%; suitable for spoons and forks.

Ashberry Metal.

Among alloys which bear a certain resemblance to Britannia metal may be mentioned Ashberry metal:

	I.	II.
Copper	2	3
Tin	8	79
Antimony	14	15
Zinc	1	2
Nickel	2	1

Bearing Metals.

Anti-friction Metal.—1.—Tin, 16 to 20 parts; antimony, 2 parts; lead, 1 part; fused together and then blended with copper, 80 parts. Used where there is much friction or high velocity.

2.—Zinc, 6 parts; tin, 1 part; copper, 20 parts. Used when the metal is exposed to violent shocks.

3.—Lead, 1 part; tin, 2 parts; zinc, 4 parts; copper, 68 parts. Used when the metal is exposed to heat.

4.—(Babbitt's.) Tin, 48 to 50 parts; antimony, 5 parts; copper, 1 part.

5.—(Fenton's.) Tin, with some zinc and a little copper.

6.—(Ordinary.) Tin, or hard pewter, with or without a small portion of antimony or copper. Without the copper it is apt to spread out under the weight of heavy machinery. Used for the bearings of locomotive engines, etc.

7.—Belgian Anti-friction Metal.—For parts exposed to much friction: Copper, 20 parts; tin, 5 parts; antimony, 0.5 part; lead, 0.25 part. For parts subjected to great concussions: Copper, 20 parts; zinc, 6 parts; tin, 1 part. For surfaces exposed to heat: Copper, 17 parts; zinc, 1 part; tin, 0.5 part; lead, 0.25 part. In making these alloys, mix all the other ingredients before adding the copper.

Babbitt Metal.—"Genuine" babbitt is composed of a small quantity of copper added to tin and antimony. No lead is used, for the adjective "genuine" is applied especially to distinguish it from the cheaper grades containing lead. There is considerable temptation to adulterate it with lead, owing to the difference in value of lead and tin; 1 lb. of lead added to 100 lb. of "genuine" makes a gain of about 18 cents. The character of the alloy would not be greatly altered, but when the purchaser pays for the best he certainly has a right to expect it. Fortunately, it is easy to detect such adulteration. Take a piece and use it for a pencil; if it makes a mark, then it contains lead, as a small amount of lead added to tin causes the latter to mark paper. The following proportions may be used in making this alloy:

1.—Copper, 4 lb.; tin, 8 lb.; antimony, 8 lb.

This forms the hardening, as it is called. First melt the copper, add the tin, and afterward the antimony; remove from the fire and let cool down to a dull red heat; then add 16 lb. more tin to increase the fusibility of the hardening. This makes 32 lb. hardening; add this to 64 lb. more tin, the proportions of tin to hardening thus being 2 to 1. The additional tin should be melted separately in a kettle or suitable vessel, and the hardening added either in ingot form or direct from the furnace; in the latter case, be sure the tin is all melted, otherwise an accident might occur by the hot metal from the furnace falling on the damp end of a projecting ingot. To prevent loss by oxidation the contents of the kettle should not be heated much above the melting point. In cases where a cheaper composition is desirable, the following can be recommended:

2.—Genuine hardening, 32 lb.; tin, 64 lb.; lead, 93 lb. This forms a good alloy. Another one is:

3.—Hardening, 16 lb.; tin, 50 lb.; antimony, 20 lb.; lead, 80 lb. In mixing this alloy, first melt a portion of the lead, say 40 lb., in the kettle, or in a crucible, in the furnace, bring to a dull-red heat, add the antimony, in small pieces, and when melted, add the balance of lead. Do not attempt to melt the antimony without the lead bath, as it is a volatile metal, and there would be a loss from oxidation. In making all alloys containing hardening a furnace is necessary to melt the copper. The following mixtures contain no copper, and are fairly good compositions:

4.—For hardening, take: Lead, 145 lb.; tin, 40 lb.; antimony, 20 lb. Melt 145 lb. of lead and 40 lb. of tin, and add 52 lb. of hardening.

5.—For hardening: Lead, 48 lb.; antimony, 26 lb. Add this amount to 152 lb. of lead. The hardening is used in this merely to form a bath for the antimony, and any portion of 200 lb. of lead may be taken. This is cheap and soft. Another cheap composition is formed as follows, and is known as "hard lead":

6.—Lead, 80 lb.; antimony, 20 lb. Hard lead is a better metal than No. 5. It is largely used for lining car journal bearings. It may be improved by the addition of tin, as in the following:

7.—Hard lead, 100 lb.; tin, 100 lb. This is given as an illustration. A great variety of alloys can be made by taking hard lead as a base and adding tin in varying quantities.

Journal Boxes, Alloy for.—Copper, 24 lb.; tin, 24 lb.; antimony, 8 lb. Melt the copper first, then add the tin, and lastly the antimony. It should be first run into ingots, then melted, and cast in the form required for the boxes.

Lining Metal, for Boxes of Railroad Cars.—Mix tin, 24 lb.; copper, 4 lb.; antimony, 8 lb. (for a hardening); then add tin, 72 lb.

White Metal.—The so-called white metals are employed almost exclusively for bearings. In the technology of mechanics an accurate distinction is made between the different kinds of metals for bearings; and they may be classed in two groups, red-brass and white metal. The red-brass bearings are characterized by great hardness and power of resistance, and are principally used for bearings of heavily loaded and rapidly revolving axles. For the axles of large and heavy flywheels, revolving at great speed, bearings of red brass are preferable to white metal, though more expensive. In recent years, many machinists have found it advantageous to substitute for the soft alloys generally in use for bearings a metal almost as hard as the axle itself. Phosphor bronze is frequently employed for this purpose, as it can easily be made as hard as wrought or cast steel. In this case the metal is used in a thin layer, and serves only, as it were, to fill out the small interstices caused by wear on the axle and bearing, the latter being usually made of some rather easily fusible alloy of lead and tin. Such bearings are very durable, but expensive, and can only be used for large machines. For small machines, running gently and uniformly, white-metal bearings are preferred, and do excellent work, if the axle is not too heavily loaded. For axles which have a high rate of revolution, bearings made of quite hard metals are chosen, and with proper care—which, indeed, must be given to bearings of any material—they will last for a long time without needing repair.

White Metals for Bearings

	Tin.	Antimony.	Zinc.	Iron.	Lead.	Copper.
German, light loads	85.00	10.00	....	....	....	5.00
German, light loads	82.00	11.00	....	....	....	7.00
German, light loads	80.00	12.00	....	....	....	8.00
German, light loads	76.00	17.00	....	....	..	7.00
German, light loads	3.00	1.00	5.00	....	3.00	1.00
German, heavy loads	90.00	8.00	....	....	....	2.00
German, heavy loads	86.81	7.62		....	....	5.57
English, heavy loads	17.47	....	76.14	....	....	5.62
English, medium loads	76.70	15.50	....	....	....	7.80
English, medium loads	72.00	26.00	....	....	....	2.00
For mills	15.00		40.00	....	42.00	3.00
For mills	....	1.00	5.00	....	5.00	...
For mills	....	1.00	10.00	....	2.00	...
Heavy axles	72.70	18.20	....	....	....	9.10
Heavy axles	38.00	6.00	47.00	....	4.00	1.00
Rapidly revolving axles	17.00	77.00	....	....	....	6.00
Very hard metal	55.00	...	....	70.00	....	2.50
Very hard metal	12.00	82.00	2.00	....	....	4.00
Cheap metal	2.00	2.00	88.00	....	....	8.00
Cheap metal	1.50	1.50	90.00	....	....	7.00

White Alloys for Bearings

	Tin.	Copper.	Antimony.	Lead.	Zinc.	Iron.
Kingston's metal with 6% of mercury added	88.0	6.0	....	....	....	....
Fenton's metal for axle boxes of locomotives and wagons	14.5	5.5	....	....	80.0	....
Stephenson's alloy	31.0	19.0	....	....	19.0	31.0
For propeller boxes	14.0	57.0	....	....	29.0	....
Dew Pance's metal for locomotives	33.3	22.2	44.4	...	....	....
Hoyle's alloy for pivot bearings	46.0	....	12.0	42.0	....	....
Jacoby's alloy	85.0	5.0	10.0	....	....	....
For propeller bush	26.0	5.0	....	....	69.0	....
Very hard bearing	12.0	4.0	82.0	....	2.0	....
Anti-friction metal	14.0	6.0	....	....	80.0	....
For general bearings	81.0	5.0	...	14.0	....	....
For general bearings	81.0	5.0	14.0	....	....	....
For general bearings	....	10.0	10.0	80.0	....	....
For general bearings	....	12.0	....	88.0	....	....
Bearings for light work	85.0	5.0	10.0	....	....	....
Bearings for light work	73.0	9.0	18.0	....	....	....
Bearings for light work	76.0	7.0	17.0	....	....	....
Bearings for heavy work	90.0	2.0	8.0	....	....	....
Bearings for heavy work	87.0	6.0	7.0	....	....	....
Bearings for common work	2.0	8.0	2.0	....	88.0	....
Soft alloy for pillow blocks	....	....	15.0	85.0	....	....
Vaucher's alloy for lining journals	18.0	....	2.5	4.5	75.0	....

White-Metal Alloys.—The following alloys are used as lining metals by the Eastern Railroad of France:

	Lead.	Antimony.	Tin.	Copper.
No. 1	65	25	..	10
No. 2	..	11.12	83.33	5.55
No. 3	70	20	10	..
No. 4	80	8	12	..

No. 1 is used for lining crosshead slides, rod brasses and axle bearings. No. 2 is used for lining axle bearings and connecting-rod brasses of heavy engines. No. 3 is used for lining eccentric straps and for bronze slide valves. No. 4 is a special alloy for metallic rod packing.

White Metal, Hard.—Sheet brass, 32 oz.; lead, 2 oz.; tin, 2 oz.; zinc, 1 oz.

Britannia Metals.

Britannia metal is an alloy consisting principally of tin and antimony. Many varieties contain only these two metals, and may be considered simply as tin hardened with antimony, while others contain, in addition, certain quantities of copper, sometimes lead, and occasionally, though rarely, on account of its cost, bismuth. Britannia metal is always of a silvery-white color, with a bluish tinge, and its hardness makes it capable of taking a high polish, which is not lost through exposure to the air. Tin, 90%, and antimony, 10%, give a composition which is the best for many purposes, especially for casting, as it fills out the molds well, and is readily fusible. In some cases, where articles made from it are to be subjected to constant wear, a harder alloy is required. In the proportions given above the metal is indeed much harder than tin, but would still soon give way under usage. A table is appended giving the composition of some of the varieties of Britannia metal and their special names:

	Tin.	Antimony.	Copper.	Zinc.	Lead.
English	81.90	16.25	1.84	....	....
English	90.62	7.81	1.46	....	....
English	90.1	6.3	3.1	0.5	....
English	85.4	9.66	0.81	3.06	....
Pewter	81.2	5.7	1.60	....	11.5
Pewter	89.3	7.6	1.8	....	1.8
Tutania	91.4	.	0.7	0.3	7.6
Queen's metal	88.5	7.1	3.5	0.9	....
German	72	24	4	..	....
German	84	9	2	5	....
German (for casting)...	20	64	10	6	....
Malleable (for casting)...	48	....	3	48	1

Britannia metal is prepared by melting the copper alone first, then adding a part of the tin and the whole of the antimony. The heat can then be quickly moderated, as the melting point of the new alloy is much lower than that of copper. Finally, the rest of the tin is added, and the mixture stirred constantly for some time to make it thoroughly homogeneous.

Britannia Metal.—A fine species of pewter.—1.—Melt together equal parts of plate brass, bismuth, antimony and tin, and add the mixture, at discretion, to melted tin, until it acquires the proper degree of color and hardness.

2.—To the last add an equal part or one-quarter of its weight of metallic arsenic. To be used as before.

3.—Melt together 1 part of antimony, 4 parts of brass, and 5 or more parts of tin. This may be used at once, as Britannia metal.

4.—*Best Britannia, for Spouts.*—Tin, 140 lb.; copper, 3 lb.; antimony, 6 lb.

5.—*Best Britannia, for Spoons.*—Tin, 100 lb.; hardening, 5 lb.; antimony, 10 lb.

6.—*Best Britannia, for Handles.*—Tin, 140 lb.; copper, 2 lb.; antimony, 5 lb.

7.—*Best Britannia, for Lamps, Pillars and Spouts.*—Tin, 300 lb.; copper, 4 lb.; antimony, 15 lb.

8.—*Britannia, for Casting.*—Tin, 100 lb.; hardening, 5 lb.; antimony, 5 lb.

9.—*Good Britannia Metal.*—Tin, 150 lb.; copper, 3 lb.; antimony, 10 lb.

10.—*Britannia Metal, Second Quality.*—Tin, 140 lb.; copper, 3 lb.; antimony, 9 lb.

11.—*Britannia Metal, for Casting.*—Tin, 210 lb.; copper, 4 lb.; antimony, 12 lb.

12.—*Britannia Metal, for Spinning.*—Tin, 100 lb.; Britannia hardening, 4 lb.; antimony, 4 lb.

13.—*Britannia Metal, for Registers.*—Tin, 100 lb.; hardening, 8 lb.; antimony, 8 lb.

14. *Hardening for Britannia.*—(To be mixed separately from the other ingredients.) Copper, 2 lb.; tin, 1 lb.

English Metal.

Tin, 88; pure copper, 2; brass, 2 (containing 75 copper and 25 zinc); nickel, 2; bismuth, 1; antimony, 8; tungsten, 2.

Tinfoil, Alloys for.

	Tin.	Copper.	Lead.	Iron.	Nic.
Mirror foil....	97.60	2.16	0.04	0.11	0.00
Jews' foil.....	98.47	0.38	0.84	0.12	0.00
Ger. "Stanniol"	96.21	0.95	2.41	0.09	0.30

Kustitien's Metal.

Take of malleable iron, 3 parts; beat it to whiteness, and add antimony, 1 part; Molucca tin, 72 parts; mix under charcoal, and cool. Used to coat iron and other metals with a surface of tin; it polishes without a blue tint, is hard, and has the advantage of being free from arsenic.

Tin-Lead.

1.—In former times, before porcelain came into general use, alloys of tin and lead were very extensively used for the manufacture of the so-called tinware, which probably never consisted of pure tin, but always of a mixture of tin and lead. Tin is one of those metals which is not at all susceptible to the action of acids, while lead, on the other hand, is very easily attacked by them. In such alloys, consequently, used for cooking utensils, the amount of lead must be limited, and should properly not exceed 10 or 15%; but cases have been known in which the so-called tin contained a third part, by weight, of lead. Alloys containing from 10 to 15% of lead have a beautiful white color, are considerably harder than pure tin, and much cheaper. Many alloys of tin and lead are very lustrous, and are used for stage jewelry and mirrors for reflecting the light of lamps, etc. An especially brilliant alloy is called "Fahlun brilliants." It is used for stage jewelry, and consists of 29 parts of tin and 19 parts of lead. It is poured into molds faceted in the same way as diamonds, and when seen by artificial light the effect is that of diamonds. Other alloys of tin and lead are employed in the manufacture of toys. These must fill the molds well, and must also be cheap, and therefore as much as 50% of lead is used. Toys can also be made from type metal, which is even cheaper than the alloys of tin and lead, but has the disadvantage of readily breaking if the articles are sharply bent. The alloys of tin and lead give very good castings, if sharp iron or brass molds are used.

2.—Tin, 82 parts; lead, 18 parts; antimony, 5 parts; zinc, 1 part; copper, 4 parts.

Pewter.—1.—Prep. (Aiken.) Tin, 100 parts; antimony, 8 parts; copper, 4 parts; bismuth, 1 part; fuse together. Very fine.

2.—Plate Pewter.—Tin, 100 parts; antimony, 8 parts; bismuth and copper, of each 2 parts. Very fine. Used to make plates, etc.

3.—Trifle.—Tin, 83 parts; antimony, 17 parts. Some lead is generally added.

4.—Ley.—Tin, 4 parts; lead, 1 part. Used for beer pots, etc.

5.—Best Pewter.—Tin, 5 lb.; lead, 1 lb.

6.—Common Pewter.—Pure tin, 82 parts; lead, 18 parts.

7.—Plate Pewter.—Tin, 90 parts; antimony, 7 parts; bismuth, 2 parts; copper, 2 parts.

Pipe Metal for Organs.—1.—Melt equal parts of tin and lead. This alloy is cast instead of rolled in the desired form of sheets, in order to obtain a crystallized metal, which produces a finer tone. The sheets are formed by casting the metal on a horizontal table, the thickness being regulated by the height of a rib or bridge at one end, over which the superfluous metal flows off. The sheets thus obtained are planed with a special plane, bent up, and soldered.

2.—The alloy is lead and tin, from 80 parts of lead and 30 parts of tin for the cheapest to 10 parts of lead and 90 parts of tin for the best quality.

Tin-Phosphorus.

1.—When finely divided tin is heated in the vapor of phosphorus a silvery-white, very brittle phosphide is obtained, containing about 21% of phosphorus.

2.—When phosphorus is dropped into molten tin, combination takes place with the formation of a white phosphide, containing about 15% of phosphorus.

3.—By placing a bar of zinc in an aqueous solution of chloride of tin, a spongy mass of metallic tin is obtained; by placing this moist tin on the top of sticks of phosphorus, in a crucible, pressing down tightly, and then exposing to a gentle heat until the flame of burning phosphorus ceases, a crystalline mass of phosphor tin is obtained.

Queen's Metal.

A very fine silver-looking metal is composed of 100 lb. of tin, 8 lb. of regulus of antimony, 1 lb. of bismuth, and 4 lb. of copper.

Stereotype Metal.

Tin, 1 part; antimony, 1 part; lead, 4 parts. In using stereotype metal, brush the type with plumbago or a small quantity of oil, then place in a frame, and take a cast with plaster of paris. The cast is dried in a very hot oven, placed face downward upon a flat plate of iron; this plate is laid in a tray or pan of iron having a lid securely fastened, and furnished with a hole at each corner. Dip the tray in the fluid metal, which will flow in at the four corners. When the tray is removed, dip the bottom only in water; and as the metal contracts in cooling, pour in melted metal at the corners, so as to keep up the fluid pressure, and obtain a good solid cast. When cool, open the tray, remove the cake of plaster and metal, and beat the edges with a mallet to remove superfluous metal. Plane the edges square, turn the back flat, in a lathe, to the required thickness, and remove any defects. If any letters are damaged, cut them out and solder in separate types instead. Finally, fix upon hardwood to the required height.

Substitutes for Pure Tin.

The metallic admixtures in tin for tin-plating are all, with the exception of iron.

poisonous, and therefore only permissible in the case of tinware not intended for use in cooking or keeping food. Besides lead, copper and iron, zinc is used, and sometimes bismuth. An admixture of zinc or of lead makes the tin a more effectual protector of iron against rust. A French alloy, especially good for coating sheet iron for constructive purposes, consists of zinc, 5.5%; lead, 23.5%; tin, 71%. If it is a question of a fine white color and high luster, 5 or 10% of bismuth may be added, making a composition of tin, 90 to 95 parts; bismuth, 10 to 15 parts. This alloy is more readily fusible than pure tin, but is more expensive on account of the high price of bismuth. Its brilliant luster adapts it especially to artistic purposes.

An admixture of ½%, or, at most, 1½%, of iron in tin, greatly increases its hardness and durability. The alloy is harmless, and can therefore be used for covering kitchen utensils, but as it is much more difficult of fusion than pure tin or alloys of tin and lead, it is not easy to make a uniform layer with it.

Remarkably beautiful and durable coatings are produced from mixtures of tin, iron and nickel; the only objection to these alloys is that they are more costly than pure tin, a fact for which, however, their great durability makes compensation. Some formulae are here given for such alloys, compositions which have stood the test of experiment:

1.—Tin, 80 parts; iron, 10 parts.

2.—Tin, 160 parts; nickel, 10 parts.

3.—Tin, 90 parts; iron, 5 parts; nickel, 7 parts.

4.—Tin, 160 parts; iron, 7 parts; nickel, 10 parts.

These alloys are made by melting the tin in a Hessian crucible, bringing it to a white heat, and adding the iron, in the form of filings, stirring vigorously with an iron rod; finally the nickel, pulverized, and heated red hot, is put in, and the mixture stirred with a hardwood stick. The decomposition of the wood by the red-hot metal causes an intimate mixture of all constituents by means of the ascending bubbles of gas. It is strongly recommended, in making these or any other alloys, to stir the metallic mass for a long time with wooden sticks; this is the only way of insuring a perfectly uniform alloy of metals which have high and different specific weights. In proceeding according to the method given, the melting of the alloy under a cover of glass or borax, often recommended, is unnecessary; if the work goes on rapidly enough, no oxidation is to be feared; and the gases evolved from the wood also act as a preventive of oxidation.—*Translated from the German of Friedrich Hartmann's "Das Verzinnen, Verzinken, Vernickeln," etc.*

Taps, Alloys for. (According to Vigoureux.)

	I.	II.	III.
Tin	78.5	80.7	71.3
Antimony	19.5	17.5	21.5
Nickel	2.0	1.8	7.0

I is for the body of the tap, II for the spigot of the plug, and III for the bushing of the plug.

Tinning, Metal for.

Malleable iron, 1 lb.; heat to whiteness; add 5 oz. of regulus of antimony and 24 lb. of Molucca tin.

Tourun-Leonard's Metal.

Composed of 500 parts of tin and 64 parts of bell metal.

Trabuk Metal.

Contains tin, 87.5 parts; nickel, 5.5 parts; antimony, 5 parts; bismuth, 5 parts. This is similar to Warne's metal.

Type Metals.

An alloy which is to serve for type metal must allow of being readily cast, fill out the molds sharply, and be as hard as possible. It is difficult to satisfy all these requirements entirely, but an alloy of antimony and lead answers the purpose best. At the present day there are a great many formulae for type metal in which other metals besides lead and antimony are used, either to make the alloy more readily fusible, as in the case of additions of bismuth, or to give it greater power of resistance, the latter being of especial importance in newspaper types, which are subjected to constant use. Copper and iron have been recommended for this purpose, but the fusibility of the alloys is greatly impaired by these, and the manufacture of the types is consequently more difficult than with an alloy of lead and antimony alone. In the following table some alloys suitable for casting type are given:

1.—	(Type Metal)		(Tungsten Alloys)							
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Lead	3	5	10	10	70	60	55	55	100	6
Antimony	1	1	1	2	18	20	25	30	30	..
Copper	..	..	..	..	2	..	..	..	8	4
Bismuth	..	..	..	1	..	..	..	..	2	..
Zinc	..	..	..	..	..	..	..	..	..	90
Tin	..	..	..	..	10	20	20	15	20	..
Nickel	..	..	..	..	..	..	..	..	8	..

2.—The French and English types contain a certain amount of tin, as shown by the following analyses:

	English Types. I.	II.	III.	French Types.
Lead	69.2	61.3	55	55
Antimony	19.5	18.8	22.7	30
Tin	9.1	20.2	22.1	15
Copper	1.7	....	....	..

3.—Ledebur gives the composition of type metal as follows:

	I.	II.	III.	IV.
Lead	75	60	80	82
Antimony	23	25	20	14.8
Tin	22	15	..	3.2

I, ordinary; II, fine; III, alloy for sticks; IV, for stereotype plates.

4.—Erhardt recommends the following as being both ductile and hard: Zinc, 89 to 93 parts; tin, 9 to 6 parts; lead, 2 to 4 parts; copper, 2 to 4 parts. The tin is first melted, and the lead, zinc and copper added successively.

The alloy given by Karmarsch, consisting of 16 parts of tin and 1 part of antimony, is much harder than lead, melts at 264°C. (about 507°F.), and can be drawn out into wire. It becomes flexible by working, and can be used in the place of pure lead for many articles.

5.—Type Metal, Alloys used for.

	Lead.	Antimony.	Tin.	Bismuth.	Copper	Zinc.	Arsenic.
Printing types	4.0	1.0	....	...	...	....	...
Printing types	7.5	2.5	....	...	0.5	....	...
Printing types	9.0	1.0	....	...	...	....	0.5
Printing types	64.0	8.0	12.0	...	...	16.0	...
Small types and stereotypes	9.0	2.0	....	2.0	...	....	...
Small types and stereotypes	16.0	4.0	5.0	...	...	....	...
Small types and stereotypes	3.0	1.0	....	...	...	....	...
Small types and stereotypes	5.0	1.0	....	...	...	....	...
Small types and stereotypes	10.0	2.0	....	1.0	...	....	...
Plates for engraving music, etc.	....	5.0	5.0	...	...	....	...
Plates for engraving music, etc.	....	2.5	7.5	...	...	....	...
Plates for engraving music, etc.	64.0	8.0	12.0	...	...	16.0	...
Plates for engraving music, etc.	60.0	2.5	37.5	...	...	....	...

6.—Nine parts of lead to 1 part of antimony forms common type metal; 7 parts of lead to 1 part of antimony is used for large and soft type; 6 parts of lead and 1 part of antimony for large type; 5 parts of lead and 1 part of antimony for middle type; 4 parts of lead and 1 part of antimony for small type; and 3 parts of lead and 1 part of antimony for the smallest kinds of type.

7.—*Erhardt's Type Metal.*—Zinc, 93%; lead, 3%; tin, 3%; copper, 2%.

8.—*Heterogeneous Metal for Music Printing Plates, etc.*—(Jean.) Tin, 10 parts; zinc, 12 parts; antimony regulus, 3 parts; copper, 1 part; lead, 74 parts.

9.—*Tutenag.*—Copper, 8 parts; nickel, 3 parts; zinc, 5 parts.

The manufacture of type from the alloy by stamping or pressing is only adopted in certain cases, the types being generally cast. The alloys, being well adapted for castings, are employed for certain kinds of ornamental work.

An alloy for keys of flutes, and similar parts of musical instruments, consists of 2 parts of lead and 1 part of antimony.

Warne's Alloy.

Tin, 37%; nickel, 26%; bismuth, 26%; cobalt, 11%.

TUNGSTEN BRONZES

In the arts, tungsten bronzes of different colors are used, namely, golden yellow, reddish yellow, purple red, and blue. The first two crystallize in forms resembling cubes, while the third is obtained partially in cubes and partially in amorphous pieces, and the last named forms prismatic crystals. Other circumstances being equal, the yellow bronze is obtained from mixtures poor in acid, the other two from those containing more acid. But the color is dependent not merely on the composition of the soda tungstate salt, but also on the amount of tin, and on the duration of the fusion; so that when much tin is used, and the fusion is prolonged, a yellow bronze is obtained from a very acid mixture, and, on the contrary, a salt that is but slightly acid, when fused only a short time and with very little tin, may yield a red or even a blue bronze.

A mixture in the proportion of 2 molecules of soda tungstate and 1 molecule of anhydrous tungstic acid, with tinfoil slowly added, and kept melted for 1 or 2 hours, will yield cubes 1-5 in. long when about 4 oz. are melted, and they will produce a yellow or reddish-yellow bronze, the powder of which seems light brown, and when stirred up with water it imparts to the liquid the property of appearing of a fine blue color by transmitted light.

The red bronze obtained from 10 parts of soda carbonate, 70 parts of soda tungstate, and 20 parts of tinfoil, yields, on pulverization, a powder that, stirred up in water, transmits green light.

According to J. Philipp, a blue bronze is always obtained, if the fused mixture contains more than 3 molecules of tungstic acid to 1 molecule of soda; if the fused product is boiled alternately with muriatic acid and with carbonate of soda, the result will be a considerable quantity of fine blue prismatic crystals, with which there are intermixed, in most cases, single red and yellow cubes. Moreover, all the tungsten bronzes obtained by fusion with tin can also be prepared by electrolysis of fused acid tungstates, but the yield is so small that it is unprofitable.

ZINC.

Bidery, Vidry.—1.—An alloy of which the chief seat of manufacture is the city of Bider, near Hyderabad, India. Many articles made of it were greatly admired at the International Exhibition of 1851. Its color is between that of pewter and zinc, does not corrode by exposure to air or damp, and can only be broken by extreme violence. Zinc, 31 parts; copper and lead, each 2 parts; melted together, with the usual precautions, under a mixture of rosin and beeswax, to prevent oxidation.

2.—(Dr. Heyne.) Copper, 8 parts; lead, 2 parts; tin, 1 part; melted as before. For use, the resulting alloy is remelted, and to every 3 parts of it 16 parts of zinc are added.

3.—Genuine Indian Bidery metal (frequently imitated in England) is about as follows:

	%	%
Copper	3.5	11.4
Zinc.	93.4	84.3
Tin	...	1.4
Lead	3.1	2.9

Zinc Bronzes (*Fontaine Moreau*).

Zn.	Cu.	Fe.	Pb.
90	8	1	1
91	8	0	1
92	8	0	0
92	7	1	0

The above may be considered the maximum of zinc and minimum of copper that will cast free of crystalline fracture. By lessening the zinc from 1 to 4%, and increasing the copper 1-8 to 1-6, a better texture may be looked for.

Zinc-Nickel.—Zinc, 9 parts; nickel, 1 part. Used for painting.

Sorel's Alloy.—This alloy has conspicuously valuable properties, which adapt it to many purposes. Its most striking characteristic is its hardness, which equals that of good wrought iron, while in tenacity it surpasses the best cast iron. In casting, it is readily detached from the mold, and can be mechanically worked with great ease, but is too brittle to be rolled out into sheets or drawn into wire. It takes all the lines of the mold exceedingly well, and on this account is much used for casting small statues, which, after careful bronzing, are given the name of cast bronze. The large proportion of zinc contained in this alloy makes the price of production comparatively low. It is quite suitable for the manufacture of articles which are to be exposed to the influences of the weather, as it does not easily rust, and becomes covered, after a while, with a thin layer of oxide, which prevents further oxidation. Two mixtures, given below, have practically the same properties, although they vary considerably in actual composition.

	I.	II.
Copper	1	10
Zinc	98	80
Iron	1	10

The iron is used in the form of cast-iron shavings, added to the zinc. The copper is then added, and the alloy kept fluid for some time, under cover of glowing coals, in order to insure an intimate combination of the metals, without the combustion of the zinc. The combustibility of the zinc makes this method of preparation difficult, however, and it is recommended, in preparing large quantities, not to mix the metals directly, but to use brass of known composition, which is to be melted down under a cover of charcoal, and slightly overheated. The zinc is then added, and finally the iron.

Stopcocks, Alloy for.—Zinc, 72 parts; tin, 21 parts; copper, 7 parts.

MISCELLANEOUS ALLOYS

Cork Metal.—At one of the recent aeronautical exhibitions samples of a metal were shown under the name of "cork metal,"* which was said to be 40% lighter than aluminum, and to have numerous other properties which should make it a rival of the latter. Great secrecy was maintained as to the nature of this wonderful metal, but its properties were such as to rouse my interest, as a consequence of which I have submitted it to chemical analysis. In appearance the metal resembles very strongly the alloys known as magnalium. The surface presents a lusterless whitish-gray color, both sheets and bars showing the scorings and scratches so frequently found on badly rolled or drawn aluminum. Careful analysis gave the following result: Aluminum, 5.04%; iron, 0.017%; zinc, 0.48%; sodium, 0.21%; magnesium, 99.30%. It will be seen, therefore, that, essentially, "cork metal" is nothing but magnesium to which a small amount of zinc has been added. Whether this latter has been purposely introduced, or, as is more probable, is merely present as an impurity, I am unable to say. As the metal evolves hydrogen when immersed in water, I found it necessary to use organic solvents for the determination of the specific gravity. In alcohol this was found to be 1.762, thus confirming the conclusion that cork metal is, in fact, magnesium.

Electric Resistances, Alloys Used for

	Copper.	Zinc.	Nickel.	Iron.	Manganese.	Aluminum.	Tungsten.
Aluminum bronze	95	..	..	..	..	5	..
German silver	60	25	14	0.3	..	..	..
German silver	55.5	20	24	0.3	0.2	..	..
Nickelin	74.5	..	25	0.5	..	..	..
Platinoid	60	24	14	..	..	..	1.2
Nickel-manganese copper	73	..	3	..	24	..	..
Manganin	84	..	12	..	4	..	..
Rheotan	84	4	..	..	12	..	..
Manganese copper	70	..	..	..	30	..	..
Manganese steel (1% C.)	..	..	..	84.5	14	..	..
Aluminum steel (2% C.)	..	..	..	94	..	5.5	..
Nickel-manganese steel (1% C.)	..	..	25	69	5	..	..

The above alloys are arranged approximately in the order of their resistances, aluminum bronze offering the least and nickel-manganese steel the greatest resistance.

Marlie's Alloy.—This alloy is also said to be non-oxidizable, like Lemarquand's alloy (see below), if the materials are pure. Nickel, 7 parts; iron and zinc, 2 parts each; brass, 5 parts; tin, 4 parts. After casting the articles they must be heated to a white heat and dipped in a mixture of acids prepared as follows: Mix 12 parts of sulphuric acid, 2 parts of nitric acid and 1 part of hydrochloric acid, and the whole diluted with 5 parts of water. Great care should be used in mixing the acids. They should be added very gradually.

Martial Regulus.—Antimony, 35 parts; iron, 5 parts.

Non-oxidizable, Alloys said to be.—Lemarquand's alloy is said to consist of: Copper, 75 parts; nickel, 14 parts; cobalt, 16 parts; tin, 18 parts; zinc, 72 parts. The metals must be pure. Marlie's alloy consists of: Iron, 10 parts; nickel, 35 parts; brass, 25 parts; tin, 20 parts; zinc, 10 parts. Articles prepared from this alloy are made white hot, and dipped into a mixture of sulphuric acid, 60 parts; nitric acid, 10 parts; hydrochloric acid, 5 parts; water, 25 parts.

Soft Alloy.—This alloy will adhere so firmly to metallic, glass and porcelain surfaces that it can be used as a solder, and is invaluable when the articles to be soldered are of such a nature that they cannot bear a high degree of temperature. It consists of finely pulverized copper or copper dust, and is obtained by precipitating copper from the sulphate by means of metallic zinc; 20, 30 or 36 parts of this copper dust, according to the hardness desired, are placed in a cast-iron or porcelain-lined mortar, and well mixed with some sulphuric acid having a specific gravity of 1.85. Add to the paste thus formed 70 parts (by weight) of mercury, constantly stirring. When thoroughly mixed, the amalgam must be carefully rinsed in warm water to remove the acid, then laid aside to cool. In 10 or 12 hours it will be hard enough to scratch tin. When it is to be used, it should be heated to a temperature of 707°F. (375° C.), when it becomes as soft as wax by kneading it in an iron mortar. In this ductile state it can be spread upon any surface, to which, as it cools and hardens, it adheres very tenaciously.

Tubania, Engestrum.—Copper, 4 parts; antimony, 8 parts; bismuth, 1 part; added to tin, 100 parts.

Tubania, English.—Brass (containing 7 parts of copper and 3 parts of zinc), 12 parts; tin, 12 parts; bismuth, 12 parts; antimony, 12 parts.

Tubania, German.—Copper, 0.4 part; tin, 3.2 parts; antimony, 42 parts.

Tubania, Spanish.—1.—Iron and steel scraps, 24 parts; antimony, 48 parts; niter, 9 parts. The iron and steel are heated to whiteness, and the antimony and niter gradually added; 2 oz. of this is alloyed with 1 lb. of tin; a little arsenic is an improvement.

2.—Iron or steel, 8 oz.; antimony, 16 oz.; niter, 3 oz. Melt and harden 8 oz. of tin with 1 oz. of this compound.

AMALGAMS

Mercury is well known to be the only metal which is liquid at ordinary temperatures. The best mercury is crystalline in character, and of a silver-white color, freezing at—40°F. and boiling at 662°. When compounded with other metals it forms alloys whose properties differ greatly according to the nature of the metals used. In most cases the amalgams are at first liquid, and afterward become crystalline, any mercury in excess being separated. The amalgams offer an excellent opportunity for studying the behavior of the metals toward each other, the low temperature at which these compounds are formed making the examination easier. If a metal is dissolved in mercury with an excess of the latter, a crystalline compound will soon separate from the originally liquid mass. This is the amalgam, whose proportions can be expressed according to fixed atomic weights, and easily obtained by removing the excess of mercury by pressure. Many amalgams are at first so soft that they can be kneaded in the hand like wax, but become hard and crystalline in time. These are especially adapted for filling teeth, and much used for that purpose. Before the action of the galvanic current upon metallic solutions was known, by means of which certain metals can be separated in a pure state from solutions, and deposited upon a given surface, the amalgams were of great importance in gilding and silvering. The article was coated with the amalgam, and the mercury volatilized by heat, the gold or silver remaining upon the surface as a coherent coat. The process was called fire gilding. The chemical affinity of other metals for mercury varies greatly; many combine with it very easily, others with such difficulty that an amalgam can only be obtained in a roundabout manner. Amalgams are of great interest theoretically, and important to a general knowledge of alloys, but only a limited number are actually employed in the industries.

Barium Amalgams.

These can, by distillation, furnish barium. It is one of the processes for preparing this metal, which, when thus obtained, almost always retains a little sodium.

Bismuth Amalgam.

Mercury and bismuth can be very easily combined by melting the latter and introducing the mercury. The resulting amalgam is very thinly fluid, and can be used for filling out very delicate molds. An addition of bismuth also makes other amalgams more thinly fluid. Such combinations are cheaper than pure bismuth amalgam, and frequently used.

Bismuth amalgams can be used for nearly all purposes for which cadmium amalgams are employed. On account of their fine luster, which equals that of silver, they are applied to special purposes, such as curved mirrors, and the preparation of anatomical specimens.

For silvering glass globes or spherical and curved mirrors, the glass is heated carefully to the melting point of the amalgam, and a small quantity of the amalgam is poured into the cavity of the globe or convex mirror, and this is swung to and fro until it shows a reflecting surface. If the amalgam is not intended to remain upon the glass, the surface is rubbed with olive oil before pouring it in, and the oil carefully wiped off. An extremely thin layer will remain, sufficient to prevent the amalgam from adhering. When it has cooled it can be removed by gently striking the glass upon a soft surface. To make concave mirrors in this way the glass is surrounded by an edge of thick paper, pasted upon the concave side of the glass, and then treated as in making convex mirrors.

If the work is properly done, the metallic surface will be perfectly bright, and will need no polishing; the trace of oil which adheres to it is removed by rubbing with ether or some other solvent. Sulphide of carbon should not, however, be used, as this liquid frequently contains small quantities of sulphur in solution, which would turn the white color of the mirror black. Mirrors prepared with bismuth amalgam acquire a yellowish tone after long exposure to the air, a phenomenon which is to be attributed to the formation of small quantities of sulphurous metals upon the surface of the mirror. They are at present little used, as curved mirrors can be more easily and cheaply prepared by the separation of silver upon them. If the very thin layer of silver which has been produced upon the surface is coated with copper by electroplating, or simply treated with a solution of asphalt in benzol, the mirror will retain its luster for an indefinite time, as the metal is perfectly protected from the access of air. The bismuth amalgam for mirrors is made of bismuth, 2 parts; lead, 2 parts; tin, 2 parts; mercury, 18 parts.

Bismuth Amalgams.—The amalgam formed of 1 part of bismuth and 4 parts of quicksilver will cause the strong adherence of glass. For the purpose of economizing the bismuth, of which the price is high, the preceding amalgam is replaced by another composed of 2 parts of quicksilver, 1 part of bismuth, 1 part of lead and 1 part of tin. The bismuth, broken into small fragments, is added to the tin and lead, previously melted in the crucible, and when the mixture of the three metals becomes fluid the quicksilver is poured in, while stirring with an iron rod. The impurities floating on the surface are removed, and when the temperature is sufficiently lowered this amalgam is slowly poured into the vessels to be tinned, which have been previously well cleaned and slightly heated. M. Ditte recommends for the same employment, as a very strong adherent to the glass, an amalgam obtained by dissolving, hot, 2 parts of bismuth and 1 part of lead in a solution of 1 part of tin in 10 parts of quicksilver. By causing a quantity of this amalgam to move around the inside of a receiver, clean, dry, and slightly heated, the surface will be covered with a thin, brilliant layer, which hardens quite rapidly.

Bismuth Amalgam for Anatomical Preparations.—For the injection of anatomical pieces, an amalgam formed of 10 parts of quicksilver, 50 parts of bismuth, 31 parts of lead and 18 parts of tin, fusible at 77.5°, and solidifiable at 60°C., is made use of; or, again, an amalgam composed of 9 parts of Darcet alloy and 1 part of quicksilver, fusible at 53°, and pasty at a still lower temperature. This last amalgam may also be used for filling carious teeth. The Darcet alloy, as known, contains 2 parts of bismuth, 1 part of lead and 1 part of tin, and melts at 93°. The addition of 1 part of quicksilver lowers the fusing point to 40°.

Fusible Alloy, for Silvering Glass.—Tin, 6 oz.; lead, 10 oz.; bismuth, 21 oz.; mercury, a small quantity.

Production of Small Statues by Means of the Amalgam of Lipowitz Metal.—This amalgam is prepared as follows: Melt in a dish, cadmium, 3 parts, by weight; tin, 4 parts; bismuth, 15 parts; lead, 8 parts; adding to the alloy, while still in fusion, 2 parts of quicksilver, previously heated to about 100°C. The amalgamation proceeds easily and smoothly. The liquid mass in the dish, which should be taken from the fire immediately upon the introduction of the mercury, is stirred until the contents solidify. While Lipowitz alloy softens at 60°C., and fuses perfectly at 70°C., the amalgam has a still lower fusing point, which lies around 62°C. This amalgam is excellently adapted for the production of impressions of various objects of nature, direct impressions of leaves, and other delicate parts of plants having been made with its aid, which in point of sharpness are equal to the best plaster casts, and are possessed of a very pleasing appearance, the amalgam having a silver-white color and a lovely gloss. It is perfectly constant to influences of the air. This amalgam has also been used with good success for the making of small statuettes and busts, which are hollow, and can be readily gilded or bronzed by electro-deposition. The production of small statues is successfully carried out by making a hollow gypsum mold of the articles to be cast, and heating the mold evenly to about 60°C.; a corresponding quantity of the molten amalgam is then poured in and the mold moved rapidly to and fro, so that the alloy is thrown against the sides all over. The shaking should be continued until it is certain that the amalgam has solidified. When the mold has cooled off it is taken apart and the seams taken off by means of a sharp knife. If the operation is carried on correctly, a chasing of the cast mass becomes unnecessary, since the alloy fills out the finest depressions of the mold with the greatest sharpness.

Cadmium Amalgam.

Cadmium combines with mercury without difficulty, forming an amalgam which readily becomes crystalline. The method of preparation of the actual cadmium amalgam, whose chemical composition is represented by the formula Cd, Hg_g, is the same as that of the other amalgams described; the mercury being heated nearly to boiling in a crucible, and the cadmium added in the form of thin sheets. Cadmium amalgam remains soft for some time, becoming crystalline only after a considerable period. The mass obtained by heating is therefore allowed to stand in the crucible until the excess of mercury separates out of its own accord; or it may be removed in the usual manner by pressing in a leather bag.

Pure cadmium amalgam is strongly crystalline, and forms a mass of a tin-white or silver-white color, which, on being moderately heated, softens, and can be worked like wax. It is used for filling teeth, either by itself or compounded with other metals, which makes it still better for the purpose. The addition of tin or bismuth makes it more pliant in the heat, and for this reason the amalgams used for filling teeth are, at present, often composed of several metals. A few compositions are herewith given, but those containing lead are not recommended. Metals possessing such distinctly poisonous properties as lead and copper are liable to be attacked by organic acids even in an amalgam, and should never be used for filling teeth, especially as the harmless compounds of cadmium, tin and bismuth answer the purpose perfectly.

	I.	II.	III.	IV.	V.
Cadmium ..	25.99	21.74	1	1 to 2	3
Mercury	74.01	78.26	..	....	..
Tin	....	....	2	2	4
Lead	....	....	..	7 to 8	15

The amalgam numbered I corresponds to the centesimal composition of the combination of mercury and cadmium described above, and is very well adapted for filling teeth. After a time it becomes so hard that it can be worked with the lathe or file, and, of course, becomes hard in the mouth. Cadmium amalgams are very ductile, and can be used for many other purposes. An amalgam of equal parts of cadmium and mercury is extremely plastic, and can be stretched under the hammer like pure gold. It is silver white in color, and not affected by the air.

Cadmium Amalgams. — Amalgams of cadmium, formed of equal weights of cadmium and quicksilver, have much power of cohesion, and are quite malleable; the case is the same with an amalgam formed of 1 part of cadmium and 2 parts of quicksilver. They are used as dental cements, for plugging teeth; for the same purpose an amalgam of 2 parts of quicksilver, 1 part of cadmium and 2 parts of tin may be used.

Evans's Metallic Cement.—This alloy is prepared by dissolving cadmium amalgam (25.99 parts of cadmium and 74.01 parts of mercury) in an excess of mercury, slightly pressing the solution in a leather bag and thoroughly kneading. If the amalgam is first heated to about 97°F., and then kneaded, it becomes as plastic as wax, and can be shaped into any desired form. On cooling, it becomes quite hard, but does not equal in this respect the pure cadmium amalgam.

Chromium Amalgam.

This amalgam has been produced by electrolyzing a solution of chromium chloride.

Copper Amalgam.

The peculiar properties of copper amalgam give it quite an important place in several branches of industry. It crystallizes very easily, and becomes so hard that it can be polished like gold. It can also be hammered or rolled, and stamped, and retains its luster for a long time in the air, unless the air contains hydrogen sulphide, in which case it quickly tarnishes and turns black. If placed in boiling water it becomes soft, and so pliable that it can be shaped into the most delicate forms, hardening again in a few hours to a very fine-grained, quite malleable mass. It was formerly recommended for filling teeth, but is no longer used for that purpose, as there are other amalgams equally suitable, and free from copper, which has a poisonous effect. An important use of copper amalgam is in cementing metals; it is only necessary to apply it to the metals, which must be bright, and previously heated to from 176 to 194°F., and press them together; they will be joined firmly.

There are many methods of preparing

copper amalgam, but the simplest and easiest is as follows: Place strips of zinc in a solution of copper sulphate, and shake vigorously. The copper thus obtained, in the form of a delicate powder, is washed and treated, while still moist, in a rubbing-dish, with a solution of mercurous nitrate. Hot water is then poured over the copper, the dish kept warm, and the mercury added. The contents of the dish are kneaded with a pestle until the powdery copper has combined with the mercury to a plastic mass, which will become the more homogeneous the longer the kneading is continued. The best proportions are 3 parts of copper to 7 parts of mercury.

When the amalgam has reached the proper consistency the water is poured off, and the soft mass molded into the form in which it is to remain. For the purpose of cementing, it has been found best to roll it into small cylinders, about ⅛ in. in diameter and ¾ to 1½ in. long. To take impressions with this amalgam, of casts made from wood carvings, the amalgam is rolled out, while warm, into a thin sheet, and pressed firmly upon the cast, also warmed. After the amalgam has hardened, the thin sheet can be made stronger by pouring over it melted type metal.

The so-called Vienna metal cement consists of the amalgam just described; and the so-called imitation gold, which, on account of its golden color and capability for taking a high polish, serves a good purpose in the manufacture of cheap jewelry, consists of copper, 86.4 parts, and mercury, 13.6 parts. As this alloy is very susceptible to hydrogen sulphide, it is advisable to give the articles a thin coating of pure gold by electroplating.

Copper Amalgams.—1.—An amalgam of 30% of copper has been employed for filling teeth. This use has been abandoned on account of the inconvenience occasioned by the great changeableness of the product.

2.—The amalgam of 30% of copper, designated by the name of "metallic mastic," is an excellent cement for repairing objects and utensils of porcelain. For this employment the broken surfaces are heated to 350°C., and a little of the amalgam, previously heated to the consistency of melted wax, is applied.

3.—Copper amalgam, of 30 to 45% of copper, rendered plastic by heating and grinding, may serve for obtaining, with slight compression, copies of delicate objects, which may, after hardening of the amalgam, be reproduced, either in wax or by galvanic process.

4.—According to Debray, when a medal, obtained with an amalgam of 45% of copper, by compression, in the soft state, in molds of gutta percha, is heated progressively to redness in an atmosphere of hydrogen, the quicksilver is volatilized gradually, and the particles of copper come together without fusion in such a way as to produce a faithful reproduction, formed exclusively of metallic copper, of the original medal.

5.—In the metallurgy of gold the crushers are furnished with amalgamated plates of copper for retaining the gold. The preparation of these plates, which are at least 3.2 millimeters in thickness, is delicate, requiring about two weeks. They are freed from greasy matter by rubbing with ashes, or, better, with a little sand and caustic soda; or, if a more rapid action is desired, with a cloth dipped in dilute nitric acid; they are washed with water, then with a solution of potassium cyanide, and finally brushed with a mixture of sal ammoniac and a little quicksilver, until the surface is completely amalgamated. They are finally made to absorb as much quicksilver as possible. But the plates thus treated are useful for only a few days when they are sufficiently covered with a layer of gold amalgam; in the meantime they occasion loss of time and of gold. So, it is preferable to cover them artificially with a little gold amalgam, which is prepared by dissolving gold in quicksilver. Sometimes the amalgam of gold is replaced by an amalgam of silver, which is readily prepared, and more economical.

6.—Another method giving better results consists in silvering copper slabs by the electroplating method, and covering them with a layer of silver of 30 or 35 grams per square decimeter. Then it is only necessary to apply a little quicksilver, which adheres quite rapidly, so that they are ready for use almost immediately, and are quite active at the outset. These amalgamation slabs ought to be cleaned before each operation. Potassium cyanide removes fatty matter, and sal ammoniac the oxides of the low metals.

7.—The following alloy of copper will attach itself firmly to surfaces of metal, glass or porcelain: Finely blended copper, 20 to 30 parts, made by reduction of oxide of copper with hydrogen, or precipitation from solution of its sulphate with zinc, are made into a paste with oil of vitriol. To this add 70 parts of mercury, and triturate well; then wash out the acid with boiling water, and allow the compound to cool. In 10 or 12 hours it becomes sufficiently hard to receive a brilliant polish, and to scratch the surface of tin or gold. When heated it becomes plastic, but does not contract on cooling.

8.—Gersnein's Alloy.—Precipitated copper, 25 to 35 parts, ground with strong sulphuric acid, in a porcelain mortar, and then 65 to 70 parts, by weight, or mercury gradually added. When the copper is well amalgamated wash well in boiling water. When required for use, make it soft and plastic by heating to 375°C. and grinding in a mortar until soft.

9.—Ironier's bronze consists of copper and tin, with 1% of mercury.

Gold Amalgam.

Gold belongs among those metals which combine easily with mercury, and a gold amalgam can be prepared by direct union of the two metals. If gold is used which has been obtained by the chemical process of reducing gold salts, it must be remembered that this, being in a finely divided state, will not dissolve easily in the mercury, for the reason that the fine powder will remain floating upon the surface. Gold, however, which has been reduced in the form of somewhat larger crystals, will dissolve in a comparatively short time. These small gold crystals can easily be obtained by dissolving gold chloride in amyl alcohol and heating the solution to the boiling point, whereby the gold will be separated in the form of small, lustrous crystals.

Gold amalgam is procured in large masses in the process of obtaining gold from auriferous sand, and by subsequent heating in iron retorts the combination is decomposed, the mercury volatilizes, and the pure gold is left behind. Gold forms with mercury a chemical combination, Au_4Hg, which has a strong tendency to crystallize. This must be prevented as much as possible in preparing the amalgam, since it is difficult to use a crystalline amalgam for gilding.

A particularly good amalgam for fire gilding is prepared as follows: Place the gold in a graphite crucible, rubbed on the inside with chalk, to prevent adhesion, and bring the crucible to a red heat. It is not absolutely necessary to use chemically pure gold. Alloyed gold will answer the purpose, but it should be at least 22 carats fine, and preferably alloyed with silver instead of copper. Gold amalgam containing copper will become as hard as stone in a short time, and even a small percentage of copper makes it difficult to apply the amalgam uniformly to metallic surfaces. It is best to use the gold in the form of thin sheets, cut into small pieces before being put into the crucible. When it is red hot put into the crucible about the eighth or ninth part of the weight of the gold, previously heated to boiling. Stir constantly with an iron rod, and after a few minutes remove the crucible from the fire. If the amalgam were allowed to cool in the crucible it would become strongly crystalline, and could not be used for fire gilding; as soon, therefore, as the crucible is taken from the fire, the contents are poured into a larger vessel filled with water, so that it may cool rapidly. The amalgam will crystallize in spite of all, if kept for any length of time; it is therefore advisable to have it freshly prepared a short time before use. In crystallizing, the amalgam separates from the mercury in excess. If this has happened, it may be restored to its proper condition by heating in a crucible with an excess of mercury. In the preparation of the amalgam, as well as in the process of gilding, it is necessary to use a wind furnace with a well drawing chimney, as the vapors evolved from the mercury are injurious to health.

Gold Amalgams.— 1. — Gilding with quicksilver.—This process of gilding, much employed formerly, is now but little used. It can be applied only to metals slightly fusible, and capable of amalgamation, like silver, copper, bronze and brass. Iron can also be gilded by this method, provided it is previously covered with a coating of copper. To perform this gilding the surface is well cleaned, and the gold amalgam, consisting of 2 parts of gold and 1 part of quicksilver, prepared as mentioned before, is applied. The piece is afterward heated to about the red, so as to volatilize the mercury. The gold remains, superficially alloyed with the metal, and forms an extremely solid layer of deadened gold, which can be afterward polished. The volatilization should be effected under a chimney having a strong draught, in order to avoid the poisonous action of the mercurial vapors.

2.—The amalgamation of gold finds its principal applications in the treatment of auriferous ores. The extraction of small spangles of gold scattered in gold-bearing sands is based on the ready dissolution of gold in quicksilver, and on the formation of an amalgam of solid gold by compression and filtering through a chamois skin, in a state more or less liquid. The spangles of gold are shaken with about their weight of quicksilver, collected in the cavities of sluices, and mixed with a small quantity of sand. The gold is dissolved and the sand remanis. The amalgam thus obtained is compressed in a chamois skin, so as to separate the excess of mercury, which passes through the pores of the skin; or, yet again, it is filtered through a glass funnel having a very slender stem, with almost capillary termination. In both cases, an amalgam of solid gold remains, which is submitted to the action of heat in a crucible or cast-iron retort, communicating with a bent iron tube, of which the extremity, surrounded with a cloth immersed in water, is arranged above a receiver half full of water. The quicksilver is vaporized and condensed in the water. The gold remains in the retort. The property of gold combining readily with quicksilver is also used in many kinds of amalgamating apparatus for extraction and in the metallurgy of gold. In various operations it is essential to keep the quicksilver active by preserving its limpidity. For this purpose, potassium cyanide and ammonium chloride are especially employed; sometimes, wood ashes, carbonate of soda, hyposulphite of soda, nitrate of potash, cupric sulphate, sea salt and lime; the latter for precipitating the soluble sulphates proceeding from the decomposition of pyrites.

The amalgamation of gold is favored by a temperature of 38 to 45°C., and still more by the employment of quicksilver in the nascent state. This last property is the base of the Designol process, which consists in treating auriferous or auro-argentiferous ores, first ground with sea salt, in revolving cylinders of cast iron, with iron and mercury bichloride, in such a way that the mercury precipitated collects the gold, and eventually the silver, more efficaciously.

Fire Gilding.—For fire gilding, or silvering, only a pure amalgam is used, such, namely, as is freed, as far as possible, from an excess of mercury. For the purpose of removing this excess the amalgam is tied up in a bag of strong chamois leather, and subjected to a gradually increasing pressure, whereby the mercury is forced through the pores of the leather. This pressed out mercury contains a considerable quantity of gold or silver, and can be used in making fresh amalgam.

Fire gilding, or silvering, is, of course, only employed with metals which will stand a temperature near that of the boiling point of mercury without melting. The amalgam will adhere only to perfectly bright metals, and the articles are subjected, before gilding, to a preparatory process, which consists in bringing them to a red heat, whereby the grease, dust, etc., adhering to the surface are burnt away, and the metal becomes covered with a film of oxide. They are then dipped into a mixture of 3 parts of nitric acid and 1 part of sulphuric acid, which quickly dissolves the oxide, leaving the metal with a bright surface. Articles which are to be heavily gilded must remain longer in the acid mixture, as a rougher surface is essential to the adherence of a large amount of the amalgam. The articles are rinsed in water, without touching them with the hands, and left in water until they are to be amalgamated, this being to prevent oxidation. The so-called amalgamation process consists in covering them with a layer of metallic mercury. The amalgamating water is prepared by dissolving 100 parts, by weight, of mercury in 110 parts, by weight, of strong nitric acid, and adding 25 parts of water. It is applied to the surface of the metal with a brush of fine brass wire. By the action of the metal upon the mercury salt, the latter is reduced to metallic mercury, in the form of very small drops, which give a white color to the metal.

When the articles are thoroughly amalgamated the amalgam is applied with a stiff scratch-brush, quickly and evenly, and they are then placed upon glowing coals. The mercury evaporates, and the gold or silver is left in a coherent layer. During the process of heating, the articles must frequently be removed from the fire and the amalgam reapplied to defective places.

The workmen employed in the process suffer greatly from the fumes of the evaporating mercury, and it must be carried on in a thoroughly well ventilated apartment, or, still better, in the open air. In spite of all precautions, however, the work is very dangerous to health, and for this reason fire gilding, though more durable than any other, is falling into disuse.

Many articles are not finished by one gilding, but the process is repeated two or three times to give a thicker coating of gold. By suitable treatment during heating, and by burning off the co-called gilders' wax, a coating of which is given to the finished article, various shades of color can be obtained.

Iron Amalgam.

Iron is one of the metals which does not combine easily with mercury, and iron amalgam, as such, is not used for plating purposes. Iron which is to be gilded or silvered in the fire must be given a coating of mercury, which is done by making the object perfectly bright by means of pickling or scouring, then rinsing in pure water and boiling in a compound consisting of 12 parts, by weight, of mercury, 1 part of zinc shavings, 2 parts of green vitriol, 1½ parts of hydrochloric acid, and 12 parts of water. The green vitriol is first dissolved in the water, the mercury added next, and finally the zinc. A porcelain vessel must be used for the boiling. The object immersed in the liquid is very quickly covered with an even, silvery coating of mercury, after which it is rinsed several times with water, dried in the air, and immediately subjected to treatment with the gold or silver amalgam. From the moment when it comes from the pickling fluid it must not be touched with the hands, for neither the mercury nor the gold amalgam would adhere to any places where it had been taken hold of. If the object cannot be fire gilded at once, it is best to keep it under a glass bell-jar, or in a box, so that it may not gather dust, and also that the mercury, which is deposited in a very thin layer upon the surface, may not gradually evaporate. If the gold amalgam is applied as soon as the object is taken from the mercury bath and rinsed, it will adhere easily and firmly.

Lead Amalgams.

These meet with an interesting employment for the autogenous soldering of lead. After the surfaces to be soldered have been well cleaned a layer of lead amalgam is applied. It is afterward sufficient to pass along the line of junction a soldering iron heated to redness, in order that the heat should cause the volatilization of the quicksilver, and that the lead, liberated in a state of fine division, should be melted and cause the adherence of the two surfaces. The only precaution necessary is to avoid breathing the mercurial vapor, which is quite poisonous.

Magnesium Amalgam.

This amalgam is slowly formed by contact of mercury with pure magnesium in the cold, but quickly at the boiling point of mercury. In this amalgam the affinities of magnesium are exalted. An amalgam containing 5% of magnesium swells up instantly in contact with air, and loses its luster; it decomposes water readily. Magnesium amalgam may also be prepared by covering sodium amalgam with a solution of magnesium sulphate.

Manganese Amalgams.

These may serve for the preparation of manganese. For this purpose it is sufficient to distil in a current of pure hydrogen. The manganese remains in the form of a grayish powder.

Platinum Metals, Amalgams of.

The platinum metals can be combined with mercury, but the amalgams thus obtained have not, thus far, found any extensive use in the industries, the process of electroplating being almost exclusively, employed in such cases.

Potassium Amalgams.

Potassium unites with mercury with great violence, and forms an amalgam similar to sodium amalgam.

Silver Amalgam.

The properties of silver amalgam are similar in most respects to those of gold amalgam, but it has a still stronger tendency to crystallize. Pure silver must be used in its preparation, as a content of copper would have the same detrimental effect upon the character of the amalgam as in the case of gold amalgam. The easiest method of making silver amalgam is by the use of silver in powdered form, obtained by reducing silver solutions. If a solution of nitrate of silver is put into a bottle with 10 or 15 parts of water, and a few small pieces of sheet zinc, and the mixture shaken vigorously for a few minutes, the silver will separate in the form of a very fine blackish-gray powder, which only needs washing and drying to be ready for the preparation of amalgam. This powder can be directly dissolved in the mercury, but it takes some time. A quicker method is to heat the mercury nearly to the boiling point in a crucible, and throw in the powdered silver, stirring vigorously with an iron rod. Silver amalgam can also be prepared without heat. In this method a concentrated solution of nitrate of silver (1 part of the nitrate in 3 parts of distilled water) is mixed with 4 times the quantity of mercury, and the liquids combined by shaking. The silver will be reduced from the nitrate by the mercury, and dissolve in the excess of it. If the amalgam is to be used for fire silvering, the small quantity of nitrate of mercury adhering to it is of no consequence, and it can be used at once.

Silver Amalgams.—1.—In the silvering of mirrors by the Petitjean method, which has almost universally replaced tinning, the property of silver in readily amalgamating is taken advantage of, by submitting the glass, after silvering, to the action of a dilute solution of double cyanide of mercury and potassium, in such a manner as to form an amalgam of white and brilliant silver adhering strongly to the glass. To facilitate the operation, and utilize all the silver, while economizing the double cyanide, M. Lenoir has recommended the following: Sprinkle the glass, at the time when it is covered with the mercurial solution, with very fine zinc powder, which precipitates the quicksilver and regulates the amalgamation.

2.—The metallurgy of silver also takes advantage of the property of this metal in combining cold with quicksilver; this for the treatment of poor silver ores.

In the Saxon or Freiberg process for treating silver ores, recourse is had to quicksilver in the state of amalgam in amalgamating casks, in which the ores after grinding, is shaken with disks of iron, and with mercury and water. The amalgam, collected and filtered under strong pressure, contains from 30 to 33% of silver. It is distilled, either in cylindrical retorts of cast iron, furnished with an exit tube immersed in the water for condensing the mercurial vapors, or on plates of iron, arranged over each other along a vertical iron stem, supported by a tripod at the bottom of a tank filled with water, and covered with an iron receiver, which is itself surrounded with ignited charcoal. It should be remarked that the last portions of quicksilver in a silver amalgam submitted to distillation are volatilized only under the action of a high and prolonged temperature.

Sodium Amalgam.

Sodium amalgam is not used by itself, as it quickly decomposes in the air into caustic soda and mercury. But it can be employed in preparing many other amalgams which cannot be made directly. If, for instance, sodium amalgam is brought together with a solution of metallic chloride, the other metal in the combination is usually separated from the chlorine by the sodium, and at the moment of the separation unites with the mercury to form an amalgam, while the sodium combines with the chlorine. The presence of a very small quantity of sodium amalgam exerts a very favorable influence upon the formation of other amalgams, and by its use in the process of obtaining gold and silver by amalgamation considerable time is saved and the amalgamation is more complete.

Sodium amalgam is prepared by melting sodium under petroleum and introducing the mercury through a very narrow glass tube. Both the metals combine at once, with a very peculiar noise, and the amalgam hardens to a silver-white mass, which, however, must be kept under petroleum until it is to be used, to prevent the oxidation of the sodium.

If sodium amalgam is put into a solution of ammonium chloride, it swells to many times its first bulk, rises to the surface of the liquid, and is converted into amalgam of ammonium, which, however, is a very unstable compound, quickly decomposed into ammonia, hydrogen and metallic mercury on exposure to the air.

Strontium Amalgams.

These amalgams, washed and dried rapidly, immediately after their preparation, and then heated to the nascent red in a current of dry hydrogen, yield a fused mass of strontium.

Tin Amalgam.

1.—This amalgam was formerly of importance for making mirrors, but at the present day mirrors coated with a thin layer of silver are more beautiful and cheaper than those prepared with amalgam. Tin has a great affinity for mercury, which makes the preparation of the amalgam easy. It is only necessary to rub the two together, the tin being best used in the form of foil or shavings. The amalgam will harden in a shorter or longer time, according to the quantity of mercury used.

2.—Tin amalgam for filling teeth is prepared by rubbing together 1 part of tin and 4 parts of mercury, removing the excess of mercury by pressing in a leather bag and kneading or rubbing. It is a flexible mass, which hardens in the course of a few days.

3.—*Amalgam for Mirrors.*—Amalgam for coating mirrors is the completely saturated compound of the two metals, hardened in a crystalline form. It is prepared directly upon the mirror plate by the following method. A sheet of tinfoil, somewhat larger than the mirror, is placed upon the silvering table, which has a marble top, adjustable by screws to either a horizontal or inclined position. After the sheet of foil has been spread out, and made perfectly smooth, a small quantity of mercury is poured over it, and evenly distributed by means of a woolen cloth. When the whole sheet has been dampened with the mercury, more is poured on, to make a layer about ⅛ in. deep, and the plate of glass, first thoroughly cleansed (which is best done with strong soda lye), is laid upon it. To do this a strip of paper is pushed in between the mercury and the layer of amalgam, at one side, the edge of the glass laid upon it, and the plate is then pushed slowly forward across the table and finally allowed to settle down upon it. The table is now slightly inclined, so that the mercury can drop off and the plate settle firmly against the amalgam. When the mercury has ceased to run off, except very slowly, soft, thick woolen cloths are spread over the plate, and weights are put on it, to press out all excess of mercury. At the same time the table is somewhat more sharply inclined. The weights may be removed in about 30 hours, as the amalgam will by this time adhere closely to the glass. The plate of glass is set up on edge, and a little more mercury will drop off. After about four weeks the mirror may be considered as finished.

If curved glass plates are to be made into mirrors, the amalgam is prepared by itself, and after spreading it as evenly as possible upon the plate, the latter is heated until the amalgam melts.

Great care must be taken to have the plates of glass perfectly clean, as the amalgam will only adhere to a bright surface. The cleansing is best performed by means of washing with strong soda lye. Since the process of making mirrors by the reduction of silver solutions upon the glass has been known, and can be quickly and cheaply carried out, the use of amalgam is falling more and more into disuse, a desirable condition in view of the fact that the work is very injurious to the health of the workmen employed, who must constantly breathe in the fumes of the mercury.

4.—An amalgam consisting of 2 parts of zinc and 1 part of tin may be used for covering the cushions of frictional electric machines. This amalgam is prepared by first melting the zinc and tin in a crucible and adding the quicksilver, previously heated.

5.—We have already spoken of the cadmium amalgam employed for plugging teeth, an amalgam of 2 parts of quicksilver, 2 parts of tin, and 1 part of cadmium. For the same purpose an amalgam of tin, silver and gold is employed.

6.—*Amalgam for Tinning.*—Small articles of iron, as pins, for example, can be tinned by first making them bright by pickling in an acid, dipping in melted tin amalgam, blanching in dilute acid, drying and polishing.

Zinc Amalgam.

Zinc amalgamates readily with mercury, it being only necessary to heat the latter to the boiling point and add the zinc in small pieces. Zinc amalgam is not employed directly, but is largely used in the zinc anodes of galvanic batteries. For this purpose it is prepared upon the zinc plate itself, by heating the latter to about 482 to 500°F., and dipping it at once into mercury, after first coating it quickly and uniformly with a solution of chloride of zinc and ammonia, applied with a brush. Amalgamation takes place immediately, and the plates thus treated give currents of greater strength and constancy than ordinary zinc plates.

Zinc Amalgams.—The principal employment of zinc amalgams is their use as a cathode or negative electrode in the batteries of Munson, Deniell and Leclanche. This combination is designed to render the zinc unattackable by the exciting liquid of the battery with open circuit. The action of the mercury is to prevent the zinc from forming a large number of small voltaic elements when foreign bodies are mingled with the metal; in a word, the giving to ordinary zinc the properties of pure zinc, and consequently of causing a great saving in expense. For amalgamating a zinc plate it is plunged for a few seconds in water in which there is 1-16 in volume of sulphuric acid, then rubbing with a copper-wire brush which has been dipped in the quicksilver. The mercury takes more readily on the zinc when, after the zinc has been cleaned with water sharpened with sulphuric acid, it is moistened with a solution of corrosive sublimate, which is reduced, and furnishes a first very thin coat of amalgam, on which the quicksilver is immediately fixed by simple immersion, without rubbing. The zinc of a battery may be amalgamated by putting at the bottom of the compartment containing each element a little quicksilver in such a way that the zinc touches the liquid. The amalgamation is effected under the influence of the current, but this process applies only on condition that the zinc alone touches the bottom of the vessel containing the quicksilver.

. CHAPTER IV

ART AND ARTISTS' MATERIALS

Constant reference should be made to the Index, also to the chapters on *Cleansing, Glass, Leather, Lapidary Arts*, etc.; also to the very full chapter on *Paints, Varnishes*, etc.

Academy Board.

1.—*Smooth*—Apply to junkboard a coating of size; when dry, spread on thick paint with a palette knife.

2.—*Rough.*—Size heavy manila paper, apply to two sheets a thick coat of paint, place the painted sides together, then pull them apart. This will give the board a roughened surface or tooth.

Books, To Gild the edges of.

To gild the edges, the book should be put into the press straight, and on a level with the cheeks of the press between cuttingboards, the boards of the book being thrown back. The press should be screwed up very tightly, and any projection of the cuttingboards should be taken away with a chisel. If the paper is unsized, or at all spongy, the edge should be sized and left to dry. This may be ascertained by wetting a leaf with the tongue; if spongy, the moisture will sink through, as in blotting paper. The edge should be scraped quite flat, and perfectly even, care being taken to scrape every part equally, or one part of the edge will be hollow, or perhaps one side scraped down, and this will make one square larger than the other. When scraped quite smooth and evenly, a mixture of black lead and thin glair water is painted over the edge, and with a hard brush it is well brushed until dry.

The gold is now cut on the gold cushion. Lift a leaf out of the book with the gold knife, lay it on the gold cushion, breathe gently on the center of the leaf to lay it flat; it can then be cut with ease to any size. The edge is now glaired evenly, and the gold is taken up with a piece of paper previously greased by drawing it over the head. The gold is then gently laid on the edge which has been glaired. The whole edge or end being done, it is allowed to get perfectly dry, which will occupy two hours.

Before using the burnisher on the gold itself some gilders lay a piece of fine paper on the gold and gently flatten it with the burnisher. Books are often treated in this manner; they then become dull gilt. When intended to be bright, a waxed cloth should be gently rubbed over the surface two or three times before using the burnisher. The beauty of burnishing depends upon the edge presenting a solid and uniform metallic surface, without any marks of the burnisher.

Gilding Books.—White of egg, well beaten up, is the ordinary sticking material used by binders to put the gold leaf on. The leather back of the book is varnished with it, and when dry a strip of gold leaf is put on the place where the letters or ornaments are to be placed; the letters used are common printing types (they must be new, however, and not been used with printing ink). They are heated a little above the boiling point of water, which is easily tried with a wet finger, and then they are pressed on the gold leaf for a few seconds only, when the heating of the albumen, or white of egg, under it fixes them to the leather of the book. The ornamental figures used are commonly made of brass, and manufactured for the use of book binders, while the type is screwed in an appropriate brass or iron holder, with wooden handle. The back of a well bound book being always round, the proper way of putting on the gilded letters and ornaments requires a certain way of manipulation, which it is best to acquire by visiting some good bookbinder's shop in the next large city, to see the operation, and use your eyes properly so as to get all little details. The sides of books being flat, it is best to put the letters and ornaments under a press. The type is put up in a proper form, it is heated, put under the press with the varnished side of the book, covered with gold leaf on the right place, and the press screwed down. Sometimes the binder puts the strip of gold leaf on the face of the type, in place of on the book. This is equally good, and, under certain circumstances, preferable.

Bronzing.

This term is applied to the process of imparting to the surfaces of figures of wood, plaster of paris, etc., a metallic appearance. This is done by first giving them a coat of oil or size varnish, and, when this is nearly dry, applying with a dabber of cotton, or a camel's-hair pencil, any of the metallic bronze powders; or the powder may be placed in a little bag of muslin and dusted over the surface, and afterward finished off with a wad of linen. The surface must be afterward varnished. (See also chapter on PAINT, VARNISHES, etc.)

1.—Mosaic gold is prepared by incorporating and grinding: tin, 16; flower of sulphur, 7; mercury, 8; and sal ammoniac, 8; then subliming the amalgam. A flaky gold-colored powder remains in the matrass.

2.—Copper powder is obtained by saturating nitrous acid with copper and then precipitating the copper by exposing iron bars in the solution.

3.—Bisulphide of tin has a golden luster, flaky texture, and is used for ornamental work, such as paper hangings, and as a substitute for gold leaf.

4.—Dutch foil, reduced to a powder by grinding, is also used; and powdered plumbago gives an iron-colored shade.

5.—Another kind is made from verdigris, 8; putty powder, 4; borax, 2; niter, 2; bichloride of mercury, ¼; grind into a paste with oil, and fuse them together.

6.—Another (red): Sulph. copper, 100; carb. soda, 60; mix and incorporate by heat; cool, powder, and add copper filings, 15; mix; keep at a white heat for 20 minutes; cool, powder, wash, and dry.

7.—Bright yellow: Copper, 83 parts; zinc, 17 parts. Orange: Copper, 90 to 95 parts; zinc, 5 to 10 parts. Copper red: Copper, 97 to 99 parts; zinc, 1 to 3 parts.

8.—Bronze powder may be mixed into a paint by using japan drier with a small percentage of boiled linseed oil. Both should be fresh.

9.—Gold Bronze Powder.—a.—Pure gold bronze powder may be made as follows: Grind leaf gold with pure honey until the leaves are broken up and minutely divided. Remove this mixture from the stone by a spatula and stir up in a basin of water; the water will melt the honey and set the gold free. Leave the basin undisturbed until the gold subsides. Pour off the water, and add fresh instead, until the honey is entirely washed away, after which collect the gold on filtering pans and dry for use.

b.—A cheaper sort may be made thus: Melt 1 lb. of tin in a crucible and pour it on ½ lb. of pure mercury; when this is solid grind it into powder, with 7 oz. of flowers of sulphur and ½ lb. of sal ammoniac.

10.—Silver Bronze Powder.—Melt together 1 oz. each of bismuth and tin, then add 1 oz. quicksilver; cool, and powder.

Burnt Wood.

A very old process of decorating wood is to burn in the design with needles of different shapes, whereby quite artistic effects may be produced, and which only requires little practice and a steady hand. The clean, smooth surface of light wood is rubbed down well, and the design sketched on lightly, or pounced on, so that the plate does not get soiled. Now a steel needle, which has been provided at the end with a covering of horn or wood, is made red hot over an alcohol flame. With this needle the sketch is worked, so that the design becomes burnt in and fixed. If it should be burnt in too deeply in places, the spot is rubbed with fine glass paper. Platinum points come with special outfits, and are more effective.

Canvas, To Prepare for Painting.

1.—Nail the canvas on the stretcher, then give it a coat of thin glue size. Allow this to dry, then apply paint of the desired tint with a palette knife. The paint should have about the consistency of that sold in artists' tubes.

2.—White lead, 1 part; whiting, 2 parts; a small portion of litharge and sulphate of zinc for driers; mix with equal parts of boiled linseed oil and raw linseed, tinted with either brown umber or lampblack, for a neutral ground. The canvas is tacked upon a stretching frame, and sized with weak glue size to which a small portion of zinc sulphate is added. When dry it is stippled over with some driers and raw linseed oil, as thin as possible, not saturated. When very nearly dry the white lead, whiting, etc., is mixed up very smooth, and put upon it very thin and smooth with a large palette knife, and hatched over with a large sash tool, drawing it across one way, and then at right angles, until the face presents a face like a piece of fine linen or cartridge paper, when it is left to dry.

Cards, To Gild the Edges of.

1.—Obtain an extremely thin leaf of gold. Put your cards together so that the edges are perfectly even. Then place in a press with the exposed edge uppermost. Coat the edge with a mixture of red chalk and water. The gold is blown out from small books, and spread on a leather cushion, where it is cut to the proper size by a smooth-edged knife. A camel's-hair pencil is dipped into white of egg mixed with water, and with this the partially dry edge is moistened; the gold is then taken up on a tip brush and applied to the moistened edge, to which it instantly adheres. When all the four edges have been gilt in this way, and allowed to remain a very few minutes, take a burnisher formed of a very smooth piece of hard stone (usually bloodstone), and rub the gold very forcibly, which gives the gold a high degree of polish. To silver edges take a brush, dip it in a saturated solution of gallic acid, and wash the edges; then dip the brush into a solution composed of 20 parts nitrate of silver to 1,000 parts distilled water. Keep on alternating these solutions until the edges assume a brilliant tint. Then wash with distilled water, and dry by free air and heat.

2.—A composition consisting of 4 parts of Armenian bole and 1 of candied sugar, ground together, with water, to a proper consistency, and laid on by a brush, with the white of an egg. This coating, when nearly dry, is smoothed by the burnisher. It is then slightly moistened by a sponge dipped in clean water, and squeezed in the hand, after which gold leaf is applied.

Carton-pierre Ornaments.

Composed of the pulp of paper, mixed with whiting and glue, pressed into plaster piece-molds, backed with paper, and, when sufficiently set, hardened by drying in a hot room. Carton-pierre ornaments are stronger and lighter than those made fo plaster of paris.

Coin Impressions.

Sharp impressions of coins may be obtained by using a mixture of equal quantities of molten, thinly liquid sulphur and infusorial earth and a little graphite. Liquefy the mixture by heat, and apply with a spoon or spatula to the coin; on cooling, an impression of great sharpness will result. The graphite prevents the impression becoming dull or unsightly.

Colored Pencils for Sketching on Glass, Porcelain, etc.

1.—*Black.*—Lampblack, 10 parts; white wax, 40 parts; tallow, 10 parts.

2.—*White.*—Zinc white, 40 parts; white wax, 20 parts; tallow, 10 parts.

3.—*Light Blue.*—Prussian blue, 10 parts; white wax, 20 parts; tallow, 10 parts.

4.—*Dark Blue.*—Prussian blue, 15 parts; gum arabic, 5 parts; tallow, 10 parts.

5.—*Yellow.*—Chrome yellow, 10 parts; wax, 20 parts; tallow, 10 parts.

The colors are mixed with the fats in warmed vessels, levigated with the same, and are then allowed to cool until they have acquired the proper consistency for being transferred to the presses. In these the mass is treated and shaped similarly as the graphite in the presses for ordinary pencils.

Colors Produced by Mixing Pigments.

According to S. Paris Davis, colors may be produced by mixtures of pigments as follows:

Bismarck Brown.—Take carmine, crimson lake and gold bronze, and mix together. If a light shade is desired, use vermilion in place of carmine.

Bottle Green.—Dutch pink and Prussian blue for ground; glaze with yellow lake.

Brick Color.—Two parts of yellow ocher, 1 of red and 1 of white.

Bronze Green.—Five parts of chrome green, 1 of black and 1 of umber.

Brown.—Three parts of red, 2 of black and 1 of yellow.

Canary Yellow.—Five parts of white and 3 parts of lemon yellow.

Carnation Red.—Three parts of lake and 1 of white.

Chestnut.—Two parts of red, 1 of black and 2 of chrome yellow.

Chocolate.—Add lake or carmine to burnt umber, or take Indian red and black to form a brown; then add yellow to bring about the desired shade.

Citron.—Three parts of red, 2 of yellow and 1 of blue.

Claret.—Red and black, or carmine and blue.

Clay Drab.—Raw sienna, raw umber and white lead, equal parts; then shade with chrome green.

Copper.—One part of red, 2 of yellow and 1 of black.

Cream.—Five parts of white, 2 of yellow and 1 of red.

Deep Buff.—The same, with the addition of a little red.

Drab.—Nine parts of white and 1 of umber.

Dove.—Red, white, blue and yellow.

Fawn.—Eight parts of white, 1 of red, 2 of yellow and 1 of umber.

Flesh.—Eight parts of white, 3 of red and 3 of chrome yellow.

French Gray.—White, shaded with ivory black.

French Red.—This color is simply Indian red, lightened with vermilion and glazed with carmine.

Gold.—White and yellow, shaded with red and blue.

Grass Green.—Three parts of yellow and 1 of Prussian blue.

Green.—Blue and yellow, or black and yellow.

Jonquil Yellow.—Mix flake white and chrome yellow, and add vermilion or carmine.

Lead.—Eight parts of white, 1 of blue and 1 of black.

Lemon.—Five parts of lemon yellow and 2 of white.

Light Buff.—Yellow ocher, tinted with white.

Light Gray.—Nine parts of white, 1 of blue and 1 of black.

Lilac.—Four parts of red, 3 of white and 1 of blue.

Maroon.—Three parts of carmine and 2 of yellow.

Medium Gray.—Eight parts of white to 2 of black.

Oak.—Five parts of white, 2 of yellow and 1 of red.

Olive.—Eight parts of yellow, 1 of blue and 1 of black.

Olive Brown.—One part of lemon yellow with 3 parts of burnt umber. Change the proportions for different shades.

Peach Blossom.—Eight parts of white, 1 of red, 1 of blue and 1 of yellow.

Pea Green.—Five parts of white and 1 of chrome green.

Pearl.—White, black and red, in proportions to suit the taste.

Plum.—Two parts of white, 1 of blue and 1 of red.

Portland Stone.—Three parts of raw umber, 3 of yellow ocher and 1 of white.

Purple.—The same as lilac, but differently proportioned; say 2 parts of blue.

Rose.—Five parts of white and 2 of carmine.

Salmon.—Five parts of white, 1 of yellow, 1 of umber and 1 of red.

Snuff.—Four parts of yellow and 2 of Vandyke brown.

Stone.—Five parts of white, 2 of yellow and 1 of burnt umber.

Straw.—Five parts of yellow, 2 of white and 1 of red.

Tan.—Five parts of burnt sienna, 2 of yellow and 1 of raw umber.

Violet.—Similar to lilac, but more red than purple.

Willow Green.—Five parts of white and 2 of verdigris.

Compositions.

See also chapter on RUBBER, GUTTA PERCHA AND CELLULOID.

1.—A mass for molding, according to a process patented by Heinrich Sommer, of Grunberg, in Silesia, can be prepared by first making a mixture of about 2-5 chalk, rather more than ½ burnt gypsum, and a small quantity of zinc white; then a second mixture of 1-3 boiled linseed, 1-5 poppy oil, 1-5 varnish, 1-5 strongly hydrated boiled glue, about 1-10 to 1-12 chalk with a small addition of zinc white and gypsum, and combining these two mixtures, before use, in the proportion of 2:1 or 3:1.

2.—*Beerit* is a material discovered by Sculptor Beer in Paris for the production of castings of the smallest and also of the largest dimensions, the outlines and tracing displaying, in both cases, a sharpness never obtainable with plaster. The casting, in about 3 hours after being run into the mold, is perfectly hard and complete, and but seldom requires working over. Beerit is said to be composed of 100 parts of marble dust, 10 to 25 parts of pulverized glass, and 5 to 10 parts of pulverized, screened lime, mixed with water glass.

3.—Substitute for Plaster of Paris.—Best whiting, 5 lb.; glue, 2½ lb.; linseed oil, 2½ lb. Heat these materials, and mix them thoroughly. After this compound has cooled, lay on a stone which is covered with powdered whitening, heat until the mass is tough and firm. Cover with wet cloths to keep moist. Ornaments may be made of this material by pressing it into a mold with a screw press. It becomes very hard after a time.

Cotton, To Gild.

The cotton should be spread with glue, dried, then coated with a thick solution of perchment size, and dried again thoroughly. Then apply the gilding.

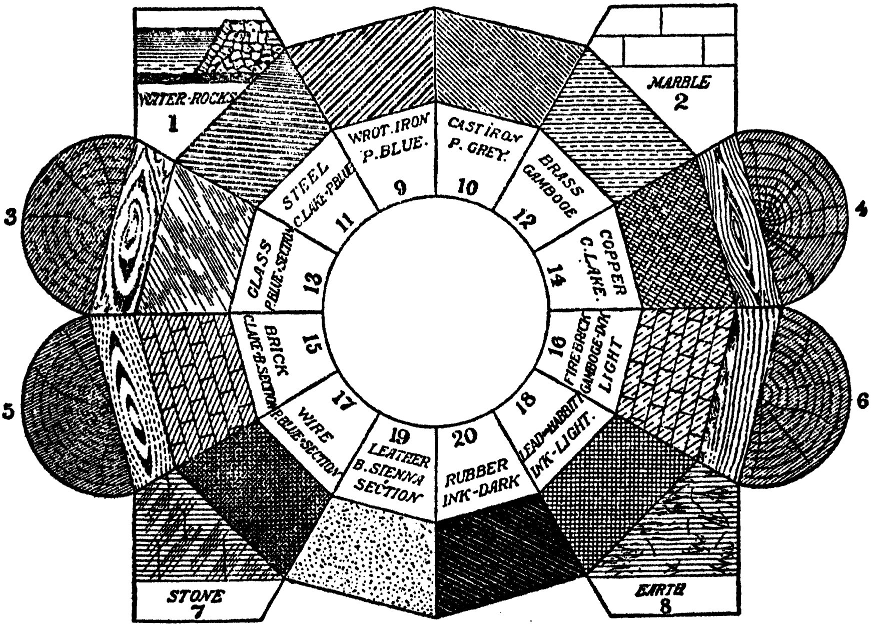
Copying Paper.

1.—The following is communicated to the *Polytechn. Notizblatt* by E. Dieterich, in regard to the method he employs for making the copying paper which has obtained so good a reputation in Germany. The manufacture may be divided into two parts, viz., the production of the color and the application of the same to the paper. For blue paper, Dieterich uses exclusively the blue color known as Paris blue, as covering better than any other mineral color. Ten kgm. of the same are coarsely ground, and mixed with 20 kgm. of ordinary olive oil; 0.25 kgm. of glycerine is then added. This mixture is exposed for a week in a drying room to a temperature of 40 to 50° C., and then ground as fine as possible in a paint mill. The glycerine softens the hard paint and tends to make it more easily diffusible. Then Dieterich melted 0.5 kgm. of yellow wax with 7.5 kgm. of ligroine, and added to this 3 kgm. of the blue mixture, mixing slowly at a temperature of 30 or 40° C. The mass is now of the consistency of honey. It is applied to the paper with a coarse brush, and afterward evenly divided and polished with a badger's-hair brush. The sheets are then dried on a table heated by steam. This is done in a few minutes, and the paper is then ready for shipment. The quantities mentioned will be sufficient for about 1,000 sheets of 50 x 90 centimeters, being a day's work for two girls. For black paper aniline black is used in the same proportion. The operation must be carried on in a well ventilated room protected from fire, on account of the combustibility of the material and the narcotic effects of the ligroine. The paper is used by being placed between two sheets of paper, the upper one receiving the original, the lower one the copy.

2.—*Permanently Moist Copying Paper.*—A perpetually damp copying paper, always ready for use, is described in *The Paper Trade Journal.* It is prepared by dissolving 1 lb. of chloride of magnesium in a moderate quantity of warm or cold water—about 1 lb. When dissolved, apply this solution with a brush to ordinary copying paper, whether in book form or otherwise, or preferably by means of cloth pads saturated with the liquid; then place these pads between any suitable number of leaves; apply pressure, at first very moderate, until the absorption by the paper is complete; then remove the cloth pads and apply with the press a strong pressure. It is then ready for use. Paper prepared by this process will remain permanently moist under ordinary temperatures, and if made dry by an extraordinary heat, will regain its moisture upon being subjected to the common atmosphere. One advantage of this method is that the sheets of paper will not adhere to each other, as is frequently the case when the paper is prepared with compounds containing glycerine, etc. The above process is patented.

Draughting.

Conventional Sectioning.—Our engraving illustrates a set of conventional sections prepared originally for use in the Sibley College of Mechanical Engineering, of Cornell University. They were prepared by Mr. J. S. Read, in charge of mechanical drawing and locomotive design in this institution. Our engraving is made from his new book, entitled "A Course in Mechanical Drawing," which has just been published by John Wiley & Sons. It is, of course, not intended that the sections should be used on either rough or hurried drawings, but they will be useful in all cases where well finished and artistic drawings are required. Fig. 1 shows a conventional method of drawing sectional rock, wall, and water. When no color is to be used, as in tracings for blueprint making, the rocks are shaded with India ink, and no color is used. A No. 175 Gillott pen is recommended. For colored drawing the groundwork is made of gamboge or burnt umber, and the water is represented by a wash of Prussian blue. No. 2 shows a conventional method of representing marble. The whole section is thoroughly wet, and then each stone is streaked with Payne's gray. Building stone is shown in the opposite corner, and is made with a light wash of Payne's gray, the shading being added with ruling and writing pens. Fig. 8 shows the method of representing earth. The body is made by washing with India ink and neutral tint with India ink in irregular penned lines. Our engraving shows four kinds of timber. No. 3 is chestnut, and is made by a ground wash of gamboge with a little crimson lake and burnt umber. The colors for graining in the sections of the chamber should be crimson, and consist of burnt umber, Payne's gray, and crimson lake, in equal but sufficient quantity to make a contrast with the ground color. Fig. 5 shows black walnut, and consists of a ground of Payne's gray, burnt umber, and crimson lake in equal quantity, using the same mixture, with the addition of some burnt umber, for the graining. Fig. 6 shows hard pine. It is colored with a light wash of crimson lake, burnt umber and gamboge, and in equal parts with a graining mixture of crimson lake and burnt umber. Woods in general are shown in Fig. 4, which should be colored with a light wash of burnt sienna, and grained with a writing pen and a dark mixture of burnt sienna and India ink. The other sections are solid wash colors, and do not call for special comment. Various other conventional sections are clearly shown in the engraving.



STANDARD CONVENTIONAL SECTIONS FOR DRAWINGS.

Draughting Paper.—Water, 15 parts; powdered tragacanth, 1½ parts; dissolve, and strain through gauze. Stretch the paper on a board, apply the mixture smoothly to it. The paper thus treated will take either oil or water colors.

Drawing Paper.

Astronomical Drawing Paper. — Felix Plateau describes in *Les Mondes* an ingenious process for drawing on paper white lines on a black ground—a method frequently used for astronomical illustrations—by means of which both author and artist are able to judge of the effect of such an illustration before putting it into the hands of the engraver. A piece of thickish paper, as smooth as possible, a little larger than the intended illustration, is heated by laying it, with proper precautions against being injured, on the top of a stove, and a piece of beeswax is rubbed over it until the paper is completely covered with a thin coating. A piece of glass, the size of the paper, is blackened by being held over a candle, and, when thoroughly cooled, it is laid on the waxed paper and rubbed thoroughly with the fingers, the result being that the blackened surface is produced on the paper, on which any design can be traced with a needle for the finer lines, or the back of a steel pen for the thicker ones.

Blue Drawing Paper.—The blue drawing paper of commerce, which is frequently employed for technical drawings, is usually little durable. For the production of a very serviceable and strong drawing paper the following process is recommended. Mix a solution of: Gum arabic, 2 c. cm.; ammonia iron citrate, 3 c. cm.; tartaric acid, 2 c. cm.; distilled water, 20 c. cm. After still adding 4 c. cm. of solution of ammonia with a solution of potassium ferrocyanide, 2.5 c. cm.; distilled water, 10.0 c. cm., and allow the mixture to stand in the dark half an hour. Apply the preparation on the paper by means of a soft brush, in artificial light, and dry in the dark. Next, expose the paper to light until it appears dark violet, place in water for 10 seconds, air a short time, wash with water, and finally dip in a solution of eau de javelle, 50 c. cm.; distilled water, 1,000 c. cm., until it turns dark blue.

Creases Out of Drawing Paper or Drawings, To Remove.—Place the drawing face downward on a sheet of smooth white paper, cover with another sheet, slightly dampened; iron with an iron moderately warm. Engravings may be treated in the same way.

Fixing on Drawing Boards.—Take a sheet of drawing paper and damp it on the back side with a wet sponge and clean water. While the paper is expanding take a spoonful of wheat flour, mix with a little cold water, and make it a moderately thick paste; spread the paste around the edge of the drawing paper 1 in. wide with a feather, then turn the drawing paper over and press the edges down on the board. After this take four straight pieces of deal wood, ¾ × 2¼ in. wide, place them on the edge of the drawing paper, and put a large book or heavy weight on each corner to make the paper adhere firmly to the board. In about an hour's time the paper will be straight and even, and quite ready for executing a drawing. When the drawing is finished take a sharp knife and raise one corner of the paper, then take a scale, run it around the edges, and the paper will come off easily. Turn it over and take the dry paste off with a knife, and all will be perfectly clean, and no paper will be wasted.

4.—*Oil Spreading, To Prevent.*—Dissolve ¼ oz. of clear gelatine in 6 oz. of hot water, strain, and apply to paper. Let it get dry before painting.

5.—*Prepared Paper.*—Paper prepared so that a brass pointer leaves a black mark on it. Dissolve ¼ oz. of pure sodium sulphide and ½ oz. of sodium hyposulphite in 1 qt. of rain water; filter the solution, and with it uniformly moisten the surface of the paper; then dry the latter under pressure between clean blotting paper.

6.—*Transparent.*—a.—Dissolve a given quantity of castor oil in 1, 2 or 3 volumes of absolute alcohol, according to the thickness of the paper, and apply with a sponge. The alcohol evaporates in a few minutes, and the tracing paper is ready for immediate use. The drawing or tracing can be made either with lead pencil or India ink, and the oil removed from the paper by immersing it in absolute alcohol, thus restoring its original capacity. The ink used must be of the waterproof variety.

b.—An American trade paper recommends saturation with benzine. In a little while the absorbed liquid is again dispersed by evaporation, and no evidence of the treatment remains.

7.—*Washable.*—Any kind of paper is lightly primed with glue or another suitable binder, to which a finely powdered inorganic body, such as zinc white, chalk, lime, or heavy spar, as well as the desired coloring matter for the paper, are added. Next, the paper thus treated is coated with soluble glass—silicate of potash or of soda—to which small amounts of magnesia have been admixed, or else it is dipped into this mixture, and dried for about 10 days in a temperature of 25° C. (77° F.). Paper thus prepared can be written or drawn upon with lead pencil, chalk, colored crayons, carbon, India ink, and lithographic crayon, and the writing or drawing may be washed off 20 or more times, entirely or partly, without the paper changing materially. Hence, paper treated as indicated presents the advantage of great economy in schools, especially schools of designing. In making designs and sketching plans, etc., it offers the convenience that anything wrong may be readily and quickly removed with a moist sponge and immediately corrected, since the washed places can be worked on again at once. This paper is preferable to the heavy slates used in teaching writing and drawing, and is commendable for that purpose, if only for the reason that it can be given any color not tiring the eye.

Drawings.

1.—*Chalk Drawings, To Fix.*—Dissolve 40 parts of alum and 20 parts of isinglass in 2,000 parts of rain water by boiling; strain the mixture through linen, and add to it about 250 parts of alcohol. The paper may be dipped in the liquid, or the latter can be poured over it.

2.—*Diagrams for Lantern Use.*—Take thin, transparent sheet zylonite, or celluloid, and wash thoroughly with water. When dry, rub with fine whiting to remove all grease. Drawings or writing can now be placed on the zylonite as easily as on paper. Tracings can be readily made which are better than those on gelatine. Clamp the finished work between two glasses 3¼ × 4 in., and bind the edge with paper.

3.—*Fixing Drawings.*—a.—Immerse the drawing in skimmed milk. A special fixative is sold for the purpose by dealers in art materials. Collodion, if very thin, might be used with advantage; often used for manuscripts.

b.—Flow with very thin collodion.

c.—Two tablespoonfuls of rice, boiled in 1 pt. or 1½ pt. of water; strain, and pass the drawing quickly through the liquid; use a large flat dish for the liquid.

d.—Prepare water starch in the manner of the laundress, of such strength as to form a jelly when cold, and then apply with a broad camel's-hair brush, as in varnishing. The same may be done with thin cold isinglass water or size, or rice water.

4.—*Mounting and Varnishing.*—Paste the drawing on the background. Flour paste is as good as any; and when it is dry, size the surface with a solution of gum arabic or white glue. When that is dry, use any varnish you please. For a delicate picture or drawing, dammar varnish is the best; but it must be applied rapidly to secure an even surface.

5.—*Mounting on Linen.*—The linen or calico is first stretched by tacking it tightly on a frame or stretcher. It is then thoroughly coated with strong size, and left until nearly dry. The sheet of paper to be mounted requires to be well covered with paste; this will be best if done twice, leaving the first coat about 10 minutes to soak into the paper. After applying the second coat place the paper on the linen and dab it all over with a clean cloth. Cut off when thoroughly dry.

6.—*Varnishing.*—a.—Put a drop or two of acetic acid in the ink, and when the drawing is dry, varnish with mastic varnish.

b.—Boil parchment cuttings until a size is produced.

Engravings, To Bleach Copper Plate.

Stir 0.5 part of chloride of lime with 2 parts of water, add 8 parts more water, stir the fluid during 2 hours, 5 or 6 times, allow it to settle, and pour off the clear fluid; dilute with 3 parts of clean water. Lay the copper-plate print between two frames covered with linen, then in a box pour the chloride of lime solution over it, and leave it standing from half an hour to an hour. Allow the fluid to run out at the bottom of the box, pour in clean water several times, take out both frames, dry partially, remove upper frame and press the print between cardboard sheets.

Engravings, To Clean. (See also Index.)

Mounting.—Strain thin muslin on a frame, then carefully paste on it the engraving, so as to be free from creases; afterward, and when dry, give the engraving two coats of thin size (made by putting a piece of glue the size of a small nut into a small cupful of hot water); finally, when this dries, varnish the engraving with a varnish known as white hard. (See also DRAWINGS.)

Flowers, How to Make Wax.

1.—This affords a pleasant way of passing time, and is useful. Use only the purest virgin wax, entirely freed from all extraneous matters. Wax that is either granular or friable must be rejected. It is generally melted in vessels of tinned iron, copper or earthenware. To render it ductile, fine Venice turpentine, white, pure, and of an agreeable odor, is added. The mixture is constantly stirred with a glass or wooden spatula. All contact with iron must be avoided, and if the vessels are of that material they must be well and carefully tinned. When stiff leaves are to be executed, 2 parts of spermaceti are added to 8 parts of wax, to give transparency. Much care and tact are needed in coloring the wax. The colors being in fine powder, are made into a paste by adding, little by little, essence of citron or lavender. When the trituration is perfect this paste is mixed with melted wax, stirring rapidly all the while; and while the mass is still liquid it is poured into molds of pasteboard or tinned iron, of the shape of tablets, and is then ready for use. Sometimes it is passed through fine muslin as it flows into the molds.

Another method is to tie up the color in a muslin bag, and wave it about among the molten wax until the desired tint is obtained. To combine colors it is only necessary to have 2 or 3 bags containing different colors, and to employ as much of each as shall have the desired effect. These bags, far from being spoiled by dipping in wax already containing other shades, have only to be rinsed in pure water to fit them for coloring other wax. The colors most in use in wax flower making are pure forms of white lead, vermilion, lake, and carmine, ultramarine, cobalt, indigo, and Prussian blue, chrome. Naples yellow, and yellow ocher. Greens and violets are chiefly made from mixtures of the above.

The wax being prepared, the manufacture of the artificial flowers is carried on in two ways. The first consists in steeping liquid wax in little wooden molds rinsed with water, around which the wax forms in a thin layer, so as to take the form of the mold, and thus to present, when detached from it, the appearance of the whole or part of a flower. In this way lilac and other simple blossoms are obtained with much rapidity.

The branches are also executed with wax, softened by heat, and molded with the fingers, round a thread of wire.

As for leaves and petals, they are cut out of sheets of colored wax of the proper thickness. These sheets are glossy on one side and velvety on the other.

To express the veining of leaves they are placed in moistened molds and pressed with the thumb sufficiently to get the impression, which is accurately copied from nature.

The petals are made to adhere simply by pressure; the leaves are placed on a little foot stalk and the latter fastened to the stem.

The manner of procuring molds for the accurate imitation of leaves is as follows: A natural leaf of the plant it is wished to imitate is spread out on a flat surface of marble, for example. It is lightly but equally greased with olive oil, and surrounded with a wall of wax, which must not touch it. Then in a small vessel containing a few spoonfuls of water a few pinches of plaster of paris are to be thrown, and briskly stirred till the liquid has the consistency of thick cream. This is poured over the leaf, and left till it is well hardened. It is then lifted up and the leaf detached, when it will be seen that the plaster has taken a perfect impression of every vein and indentation. Such molds are rendered far more durable if they are impregnated, while warm, with drying oil. This gives them greater solidity, and prevents their crumbling from frequent immersion in water.

It is necessary to impress strongly on all amateur wax flower makers the necessity for having all tools and molds completely moistened with water, otherwise the wax will be constantly adhering, and preventing neatness of workmanship.

2.—Get a sheet of glass, 18 in. square. Put some soft soap in hot water, in a bath, and stir it until it lathers. Warm some of the wax, as for fruit, adding a little balsam fir; color according to the work in hand. When the soap-water in the bath is blood-warm, and the wax melted and colored, steep the glass in the water, take it out, plunge it into the warm wax, and when it has an even coat of wax on it plunge it into the water again, so obtaining a smooth sheet of wax. Lay this on the board, dry it, and lay a natural leaf on it, making the veins on the wax with the thumbnail. Cut out the shape of the leaf with a sharp penknife, and curl by bending over the finger or back of the hand. Join the leaves by the aid of fine wire, and mount under a glass case. Practice in making leaves will lead to the making of flowers, which are more difficult than fruit or leaves, as there are no molds. Take a rose, for instance; every leaf has to be made separately, of very thin wax, and joined by wire. Keep on trying, however, as the same wax will do over and over again. The following short table serves as a guide to coloring. "Cast" means the color the wax should be made while warm. "Applied" means put on dry after fruit is completed. Always get a fine specimen to copy:

Fruit or Article	Cast	Applied
Apples	Chrome yellow	Greenish touches
Banana Melon	Chrome yellow	Greenish touches
Cherries	White or pale yellow	Touched up with lake
Egg Plums	Chrome yellow	Touched up greenish
Filberts	Green	
Oranges	Different parts yellow and red lead well mixed in the wax before casting	
Pears	Yellow	Touched up to nature
Plums	Prussian blue and red well mixed before casting	
Pineapple	Yellow	Experiment with gamboge
Pomegranate	Burnt umber	Touched up with purple
Peach	White	Touched up with chrome yellow and lake
An Egg	White	Touched up with chalk

Cleanliness is indispensable; not a particle of dirt must be near the work. In mixing the plaster, always remove all traces of one lot before preparing the next.

Fruit, How to Make Wax.

The necessary things include 4 lb. of medium sand, a large pie dish, a pudding basin, a wooden spoon, and a small table knife. For the mold obtain a 7-lb. bag of best fine plaster of paris; for the model 3 or 4 lb. of best white wax. It will also be necessary to have a small quantity of each of the following dry colors: Prussian blue, ultramarine blue, carmine, chrome yellow, rose pink, purple, scarlet powder, No. 1 chrome green, No. 2 chrome green, and any other colors that taste may suggest. One bottle of balsam fir and some fine wire will also be needed. Begin by making a lemon. Take the basin, and stand a lemon upright in it; surround the lemon evenly with sand till exactly half has been covered, so that one-half projects from an even layer of sand. Now encircle the visible half of the lemon by a band of pasteboard 2 in. high, and exactly 1 in. larger in circumference than the fruit. In the pie dish mix enough plaster of paris to the thickness of a stiff cream to cover the half of the lemon with a coat ½ in. thick. Having got it to the right thickness, pour it over the half lemon, taking care that an even coat is deposited. The cardboard circle will prevent the plaster running away. Leave it alone until it is hard enough to handle, then take it up gently, take out the fruit without injuring the fine indentations of the peel in the interior of the shell, remove any sand that may be clinging to the base of the half mold, and make in the rim of it four holes, each large enough to hold a pea. Grease the rim and holes with a little oil and fat, mixed; replace the lemon in the mold exactly as it was when removed, taking great care in that respect; fix a card rim around the outer edge of the half mold, and the mold can then be completed. Wash from the utensils all traces of the previous plaster; this is most important. Mix fresh plaster, and pour it over the other half of the lemon, taking care that this is as thick as that previously mixed. The fruit is now completely coated with plaster. Let this dry as before; when it is ready, insert a knife between the joints and pry it apart without damaging the interior; take out the fruit, and the mold is complete. Let the mold rest for half an hour. Casting the wax is the easiest part of the business. Melt in a covered basin enough wax nearly to filll one of the halves of the mold, and while it is warm well mix with it sufficient chrome yellow. Now take the mold and immerse it in hot water for a minute; then add a little balsam fir to the wax, and pour it into one of the half molds. Fix the other half on, and, taking the mold in the hands, press the halves together, and shake the whole in such a way that the wax is run evenly over the interior of the mold. Do this for a few minutes, then plunge the hands, with the mold, into cold water, and leave it there for two minutes; take it out, open the mold, and the lemon will be complete, unless it is desired to touch up the ends with No. 2 chrome green. In this way almost anything that is moldable—including fruits, nuts, vegetables, etc.—may be made; and wax-working is not only instructive and pleasant, but, in the hands of a smart person, remunerative.

Gilding.

See also chapter relating to GLASS, LEATHER, etc.; also PICTURE FRAMES, MARBLE, etc., in this section. The special chapter relating to LAPIDARY ARTS, HORN, BONE, etc., should be consulted, as well as the Index.

Oil Gilding.—This species of gilding may be divided into several operations.

1.—The surface is prepared by a coating of white lead in drying oil.

2.—Another coat is given, made with calcined white lead or masiscot, ground in linseed oil and turpentine; three or four coats of this mixture are often given, observing to carefully smooth off each coat with pumice or shave grass before the application of the following ones.

3.—The gold color, or paint, is next applied. It is usually very adhesive gold size, or the bottom of the pot or dish in which painters wash their brushes. For this purpose it is thoroughly ground and strained.

4.—When the gold color becomes partially dry, and sufficiently tenacious, the gold leaf is applied, and pressed on with a wad of cotton, wood, or a soft brush.

Oil Size for Gilding.—Grind calcined red ocher with the best and oldest drying oil, and mix with it a little oil of turpentine when used. When the work is to be gilded, first give it a coat of parchment size, then apply the above size, where requisite, either in patterns or letters, and let it remain till, by touching it with the finger, it feels just sticky; then apply the gold leaf, and dab it on with a little piece of cotton; in about an hour wash off the superfluous gold with a sponge and water, and when dry varnish with copal varnish.

Size for Bronzing and Gilding.—A combination of asphaltum, drying oil and spirits of turpentine will be found useful as a size for bronzing and pale gilding. A size for cloth, silk, etc., may be made by taking a little honey mixed with thick glue. This is to be reduced to a proper consistency, and it then has the effect of giving a fine bright luster.

Wax, Gilder's, Production of.—For the production of various colorings of gold in fire gilding, the respective places are frequently covered with so-called gilder's wax. Same consists of mixtures of various chemicals which have an etching action in the red heat upon the bronze mass, thus causing roughness of unequal depth, as well as through the fact that the composition of the bronze is changed somewhat on the surface, a relief of the gold color being effected in consequence of these two circumstances. The gilding wax is prepared by melting together the finely powdered chemicals with wax according to the following recipes:

	I.	II.	III.	IV.	V.
Yellow wax	32	32	32	96	36
Red chalk	3	24	18	48	18
Verdigris	2	4	18	32	18
Burnt alum	2	4	..	..	..
Burnt borax	..	..	2	1	3
Copper ash	..	4	6	20	8
Zinc vitriol	..	..	..	32	18
Green vitriol	..	..	..	1	6

Glass.

Bronze Drawing on Glass Plates.—After the glass has been polished clean, take a solution of isinglass, the same as used for gilding, and by means of a soft otter's-hair brush apply it quickly to the glass. It is, of course, understood that the solution must be carefully filtered. Then the galss is held by the corners, obliquely over the flame of a lamp, so that the fluid runs off until it is perfectly dry. The position must not be changed, otherwise ridges will be produced on the surface. When the glass has been prepared in this manner write firmly on it. By this means, lettering, etc., in microscopic proportions, can be done. It is best to use a drawing pen. The glass remains perfectly clear and clean, and it is not necessary to wash it off. Aquarelle colors may also be used, and, for outlining, India ink. (See also special chapter on GLASS.)

Granite, Gilding on.

Apply a coat of size and then two or three coats of size and fine powdered whiting. Let each coat dry, and rub down with fine glass paper before the next is applied. Then go over it thinly and evenly with gold size, and apply the gold leaf.

Lithographic Paper.

To prevent ink from adhering to and sinking into lithographic paper, which would render a perfect transfer to the stone impossible, the following plans are used:

1.—Coat the paper with 3 successive layers of sheep's-foot jelly, 1 of cold starch and 1 of gamboge. The first coat is applied by a sponge dipped in the hot solution of jelly, thinly but very evenly over the whole surface; the others are applied in succession, each previous one being allowed to dry first. When the paper is dry it is smoothed by passing through the lithographic press.

2.—Cover rather strong unsized paper with a varnish composed of 120 parts starch, 40 of gum arabic, and 20 of alum. Make a moderate paste of the starch by boiling, dissolve the gum and alum separately, and then mix all together. When well mixed, apply hot, with a flat, smooth brush, to the leaves of paper. Dry, and smooth by passing under the press.

3.—This paper, which is written upon with lithographic ink, may be prepared by either of the following formulae: Take starch, 6 oz.; gum arabic, 2 oz.; alum, 1 oz. Make a strong solution of each, separately, in hot water, then mix the whole, and strain the liquor through gauze. It must be applied to one side of the paper while still warm by means of a soft brush or sponge. A second or third coating may be given as the preceding one becomes dry. The paper is finally pressed to render it smooth.

4.—The paper must first receive 3 coats of thin size, 1 coat of good white starch, and 1 coat of a weak solution of gamboge in water. The ingredients are to be applied cold with a sponge, and each coat allowed to dry before the next is applied.

Maps.

Backing Maps with Muslin.—Stretch your muslin (ordinary cotton stuff) on a wooden stretcher by means of tacks, cover your map on the back with an even and thin coat of good boiled starch or flour paste, or other sticking material, no matter what, if it only sticks. Lay the map on the cloth, only taking care to do this smoothly and to avoid wrinkles; rub it evenly down after temporarily covering the place you rub with a piece of clean paper, so as to avoid friction over the map itself. Let it dry, and the work is done. In order to avoid wrinkles, it is quite essential to let your paper map, after being covered with the starch paste, soak for a few minutes, so as to give the paper a chance to expand from the moisture. It will then, while contracting from the drying, obtain a very smoothly stretched surface. Bookbinders always carefully observe this when pasting papers on book covers, etc.

1.—*Map Colors.*—Blue.—A weak mixture of sulphate of indigo and water, to which add a small quantity of gum.

2.—Green.—Dissolve crystals of verdigris in water, and add a small quantity of gum.

3.—Red.—Make a decoction of Brazil dust in vinegar and a small quantity of gum and alum; or make an infusion of cochineal and add a little gum.

4.—Yellow.—Dissolve gamboge in water, or make a decoction of French berries, strain, and add a small quantity of gum arabic.

1.—*To Mount Maps.*—Stretch smooth factory cloth upon a frame and coat it with glue size. Before this dries apply a strong flour paste to the back of the map and lay it smoothly on the cloth. Let it remain until perfectly dry. If the map is to be varnished, apply two or three coats of isinglass size, and after it becomes thoroughly dry flow on a coat of varnish consisting of balsam of fir diluted to the proper consistency with turpentine.

2.—Stretch the muslin on a flat table, tacking the edges, if necessary; spread the paper face downward on another table, and rub it over with perfectly smooth flour paste. If necessary, the paste must be passed through a fine wire sieve. If properly made, this will not be required. Then lift the paper and place it, paste side downward, on the muslin. Lay another piece over it, and rub it down with the hand.

Relief Maps.—Suppose you have a map of a section of country on which are marked contour lines, made by passing horizontal planes at vertical distances of 10 ft., or any other distance. Take sheets of cardboard so that the thickness shall represent 1 ft., then 10 superposed will give 10 ft. The thickness of the cardboard is, of course, the unit of your scale, both vertical and horizontal. Now cut out pieces of cardboard of the same size and shape as the horizontal space embraced by the different contour lines. Then on your map draw in between the contour lines and approximately parallel to the nine other lines, and cut pieces of cardboard corresponding to them. Superpose these in their regular order, and you have the rough formation in relief of your map. The pieces of cardboard are pasted together and carefully pressed to keep the whole mass uniform. Then smear wax over the whole, in order to make a smooth surface. Different colors will represent roads, grass, rivers, etc. Trees or forests can be represented by dried green moss. Houses and other buildings and constructions are made of wax. In the practical work of making such a map, other details may come up, but they will generally be such as will present little difficulty to any one at all conversant with modeling. The chief difficulty lies in procuring maps with contour lines marked on them.

Marble.

Artificial.—A new process by L. Beaumel has for its purpose the production of imitation of statuary marble, onyx, and other multicolored kinds of stone. The mass used consists of alum and heavy spar (barium sulphate), with the addition of water and the requisite pigments.

The following proportions have been found to be very serviceable: Alum, 1,000; heavy spar, 10 to 100; water, 100; the amount of heavy spar being governed by the degree of translucence desired.

The alum is dissolved in water with the use of heat. As soon as the solution boils mix in the heavy spar, stirred with water and the pigment; boil down until the mixture has lost about 3% of its weight, at which moment the mass exhibits a density of 34° B. at a temperature of 100° C. Allow to cool, with constant stirring, until the substance is semiliquid.

The resultant mass is poured into a mold covered on the inside with several layers of collodion, and the cast permitted to cool completely in the mold, whereupon it is taken out and dried entirely in an airy room. Subsequently the object may be polished, patinized, or finished in some other way.

Gilding Letters on.—Apply a coating of size first, then apply successively several coats of size thickened with whiting, until a good face is produced. Let each coat dry, and rub it down with fine glass paper before applying the next. Then go over the marble thinly and evenly with gold size. Apply the gold leaf, and burnish with an agate. The gold leaf must be applied several times to give a good effect.

Modeling Compounds and Waxes for Artistic Purposes.

1.—*Clay.*—Knead dry clay with glycerine instead of water, work thoroughly with the hands, moisten work at intervals of 2 or 3 days, keep covered with an old piece of rubber cloth to prevent evaporation of moisture.

2.—*Sculptor's Putty.*—Mix 200 parts of dry clay or powdered soapstone with 100 parts of wheat flour; stir the mixture carefully into 300 parts of melted white wax, not too hot. If desired, the mass may be colored at pleasure. The so-called "modeling clay" may be made by kneading dry clay with glycerine instead of water. The mass must be worked thoroughly with the hands, and moistened at intervals of 2 or 3 days. To prevent evaporation, it should be kept covered with a piece of rubber cloth.

3.—*Wax.*—a.—Yellow wax, 16 oz.; corn starch, 8 oz.; Venice turpentine, 4 oz.; olive oil, 1 oz.; Venetian red, 1 oz. Melt the wax and oil, to which add the corn starch and Venetian red, constantly stirring; lastly add the Venice turpentine. Pour the mixture in thin layers upon greased tiles, and when cold remove and roll into bundles.

b.—In the following the first column gives the proportions for a soft wax, the second for a harder one

	Parts.	Parts.
White wax	64	64
Lard	8	4
Venice turpentine	8	3
Burgundy pitch	8	7
Color	8	8

The soft wax is used for large models, the hard for small ones. Any earthy color may be used.

c.—For summer use: White wax, 20 parts; soft turpentine, 4 parts; benne oil, 1 part; cinnabar, 2 parts.

d.—For winter use: White wax, 10 parts; soft turpentine, 3 parts; benne oil, 1 part; cinnabar, 1 part.

e.—Work up pure beeswax, either the natural yellow or bleached, as desired, in twice its weight of spirit of turpentine. Color with yellow or red ocher, or with alkanet. Put the ochers into the turpentine at the same time as the wax, steep the alkanet in the essence for 12 hours or so before, and decant off the clear-colored liquid. No heat is used.

f.—Melt 20 oz. best white wax, and while it is cooling mix with 1 oz. of flake white.

g.—Best yellow wax, 50 parts; Venice turpentine, 7 parts; lard, 3¼ parts; bole elutriated, 36 parts; mix, and knead thoroughly.

h.—White wax, melted, and mixed with lard to make it workable. In working it the tools used, the board or stone, are moistened with water to prevent its adhering; it may be colored to any desirable tint with a dry color.

i.—Engravers' Border Wax.—(1)—Beeswax, 1 part; pitch, 2 parts; tallow, 1 part.

(2)—Rosin, 3 oz.; beeswax, 2 oz.; sweet oil, q. s. Incorporate thoroughly by heat, turn into cold water, and work thoroughly with the hands; if brittle, melt again, and add more oil.

k.—Engraving Wax.—The following is said to be a good receipt for map engraving wax: Linseed oil, 4 oz.; gum benzoin, ½ oz.; white wax, ½ oz.; boil two-thirds.

l.—Impression Wax.—Temper paraffine wax with olive oil to suit conditions. Mix a little whiting with it while hot.

m.—*Repairing Wax Dummies.*—For repairing cracks in the face, etc., of wax dummies, a suitable composition may be made by melting 3 parts of white wax with, say, 1 part of clarified lard. More or less lard will make it softer or harder, as desired. If it is wished to be of the same general tone as the figure, the necessary color, in dry powder, may be added in melting; or the new work may be made to match afterward with dry color and a camel's-hair brush. If the repair is in the mouth, eyebrows, etc., tube oil color may be necessary. A few drops of balsam fir added to the wax will prevent it from melting in the sun. The tools for smoothing down should be of polished boxwood, or better, of bone; in form they are like the human thumb, but on a smaller scale. Such modeling tools can be bought at the larger tool shops and of artists' colormen. Failing anything better, a rounded toothbrush handle will serve the purpose. Wetting the tool will prevent the wax sticking.

Molds.

1.—*Alloys.*—Plaster of paris, mixed with equal parts of powdered pumicestone, makes a fine mold for casting fusible metals. The same mixture is useful for incasing articles to be soldered or brazed. Casts of plaster of paris may be made to imitate fine bronzes by giving them two or three coats of shellac varnish, and when dry applying a coat of mastic varnish and dusting on fine bronze powder when the mastic varnish becomes sticky.

2.—*Blackening for Molds.*—Charcoal powder, or, in some instances, fine coal dust.

3.—*Gelatine.*—a.—Allow 12 oz. of gelatine to soak for a few hours in water until it has absorbed as much as it can, then apply heat, by which it will liquefy. If the mold is required to be elastic, add 3 oz. of molasses and mix well with the gelatine. If a little chrome alum (precise proportions are immaterial) be added to the gelatine, it causes it to lose its property of being again dissolved in water. A saturated solution of bichromate of potash, brushed over the surface of the mold, allowed to become dry, and afterward exposed to sunlight for a few minutes, renders the surface so hard as to be unaffected by moisture.

b.—Take the very best glue you can get, place it in plenty of cold water at night; the next morning take it out, and you will find it swollen; the water it has absorbed during the night is sufficient to melt it by heat; mix then as much thick glycerine with it as you had glue, and keep the vessel containing them in a steam or water bath till all the water is about evaporated, and till you have left as much in weight as the weight of the dry glue and the glycerine, taken together, amounted to. You will then have a compound of glue and glycerine which will never dry, and a mold made of it can be used over and over again.

c.—A good gelatine mold may be made in the following manner: Soak the best white glue in cold water for 24 hours, then drain off all the water. Melt the soaked glue in a water-jacketed kettle, then pour the glue upon the object, the latter being incased in a lead or pasteboard box. Let it cool for 12 hours, then separate the cast from the object. If the object be a statuette, a thread should be attached to the back, and extended out of the mold at both ends, so that it may be used for cutting open the mold after it has cooled, to permit of taking out the statuette. A good material for a mold is made in the following way: Dissolve 20 parts of fine gelatine in 100 parts of hot water, and add ½ part of tannin and the same amount of rock candy. It is said that a mold made of gelatine or glue alone may be made more durable by pouring over it a solution of bichromate of potash in water, 1 part of bichromate to 10 parts of water, and afterward exposing it to sunlight. Most objects require oiling slightly before being covered with glue or gelatine.

4.—*Paraffine Molds for Plaster Casts.*—Prepare the specimen or preparation, making it as clean as possible; place on oiled paper, in a position that will show it to advantage. Soft projections may be held in position with threads suspended from a frame or from a heavy cord stretched across the room. Paraffine, melted in a water bath, is painted over the preparation with a soft brush, the first layer being put on with single and quick strokes, that the rapid cooling of the paraffine may not cause the brush to adhere to the preparation, thus drawing the soft tissues out of place, until the mold is formed about ⅛ in. thick; all undercuts must be well filled. When the mold is hard it can be readily separated from the preparation; it is then well washed with cold water. Stir fine dental plaster into cold water to the consistency of cream, pour into the mold and out again several times, so that there will be no air bubbles on the surface, then fill the mold and let it stand until hard. Place the whole in a vessel containing boiling water until the paraffine is all melted; wash with clean boiling water. When the cast is thoroughly dry it may be painted with oil colors by coating it first with shellac varnish. Casts of any part of the body may be made from a living subject if the parts are not too sensitive to bear the heat of the paraffine, which is about 150° F.

5.—*Statuary.*—The flexible molds referred to are prepared as follows: Glue, 8 lb.; molasses (New Orleans), 7 lb. Soak the glue overnight in a small quantity of cold water, then melt it by heat over a salt-water bath, stir until froth begins to rise, then add and stir in briskly the molasses, previously heated. Continue to heat and stir the mixture for about half an hour, then pour.

6.—*Wax.*—Whether the beeswax have stearine in it or not, it is best to prepare it in the following manner: Put some common virgin wax into an earthenware pot or pipkin, and place it over a slow fire; and when it is all melted stir into it a little white lead (flake white), or black lead (plumbago), say about 1 oz. white lead to 1 lb. wax; this mixture tends to prevent the mold from cracking in the cooling, and from floating in the solution; the mixture should be remelted two or three times before using it for the first time. Rosin has been recommended as a mixture with wax, mixtures of which, in various proportions, have been used with success; but when often used, decomposition or some change takes place, which makes the mixture granular and flexible, rendering it less useful for taking molds. When rosin is used, the mixture, when first melted, should be boiled, or nearly so, and kept at that heat until effervescence ceases; it is then to be poured out upon a flat plate to cool, after which it may be used as described.

Paper.

Gold Leaves, To Apply.—Glaire, which is pure albumen, is sometimes used. It is made by shaking up the white of an egg with a few drops of ammonia and drawing off the clear liquid, which has subsided on standing. This is painted on the lines, and by slight heat, as of a hot iron, the leaf adheres. Gold size is used on thick paper, or thick gum arabic water may be used. The illuminators of to-day cannot get as good results as did the old workers of the Middle Ages. The old gilding is never equaled now.

Paper Casts from the Antique.

This method of obtaining facsimiles of sculpture in basso-relievo is very easy. Stiff, unsized, common white paper is best adapted for the purpose. It should be well damped, and, when applied to sculpture still retaining its color, not to injure the latter care should be taken that the side of the paper placed on the figures be dry; that is, not the side which has been sponged. The paper, when applied to the sculpture, should be evenly patted with a napkin folded rather stiffly; and if any part of the figures or hieroglyphics be in intaglio, or elaborately worked, it is better to press the paper over that part with the finger. Five minutes is quite sufficient time to make a cast of this description; when taken off the wall it should be laid on the ground or sand to dry.

Papier Mache.

1.—The following are the ingredients necessary to make a lump of papier mache a little larger than an ordinary baseball, and weighing 17 oz.: Wet paper pulp (dry paper, 1 oz.; water, 3 oz.), 4 oz. averdupois; dry plaster of paris, 8 oz. averdupois; hot glue, ½ gill, or 4½ tablespoonfuls.

While the paper pulp is being prepared melt some best Irish glue in the glue pot, and make it of the same thickness and general consistency as that used by cabinetmakers. Measure the different ingredients to be used, until the result teaches you what good papier mache is like, and after that you can be guided by your judgment as you proceed. On taking the paper pulp from the water give it a gentle squeeze, but by no means squeeze it as dry as you can. Now put it in a bowl, put over it 3 tablespoonfuls of your hot glue, and stir the mass up into a soft and very sticky paste. Next add your plaster of paris, and mix it thoroughly. By the time you have used about 3 oz. of the plaster the mass is so dry and thick you can hardly work it. Now add the remainder of your glue, work it up again until it becomes sticky once more, then add the remainder of your plaster. Squeeze it vigorously through your fingers to thoroughly mix the mass, and work it until it is free from lumps, is finely kneaded, and is sticky enough to stick fast to the surface of a planed board when you rub it a bit on it by firm pressure of the finger. If it is too dry to stick fast, add a few drops of either glue or water, it makes little difference which, and work it up again. When the paper pulp is poor, and the mache is inclined to be lumpy, lay the mass upon a smooth board, take a hammer and pound it hard to grind it up fine.

If the papier mache is not sticky enough to stick fast to whatever a bit of it is rubbed upon, it is a failure, and requires more glue. In using it the mass should be kept in a lump, and used as soon as possible after it is made. Keep the surface of the lump moist by means of a wet cloth laid over it, for if you do not, the surface will dry rapidly. If you wish to keep it overnight, or longer, wrap it up in several thicknesses of wet cotton cloth and put it under an inverted bowl. If it should by accident or delay become a trifle too stiff to work well, add a few drops of water to the mass, pound it with the hammer, and work it over again. If you wish to keep a lump for a week, to use daily, add a few drops of glycerine when you make it, so that it will dry more slowly.

The papier mache made when the above formula was prepared had the following qualities: When tested by rubbing between the thumb and finger, it was sticky, and covered the thumb with a thin coating. (Had it left the thumb clean it would have been because it contained too much water.) When rubbed upon a pane of glass it stuck tightly, and dried hard in three hours without cracking, and could only be removed with a knife. When spread in a layer as thin as writing paper it dried in half an hour. A mass actually used dried hard enough to coat with wax in 18 hours, and, without cracking, became as hard as wood; yet a similar quantity wrapped in a wet cloth and placed under an inverted bowl kept soft and fit for use for an entire week.

Such are the qualities of first-class papier mache, and the method of producing it.

2.—Papier mache is obtained from old paper, and the like, made into a pulp by grinding with milk of lime or lime water, and a little gum dextrin or starch. This pulp is then pressed into form, coated with linseed oil, baked at a high temperature, and finally varnished. The pulp is sometimes mixed with clay (kaolin), chalk, etc.; and other kinds are made of a paste of pulp and recently slaked lime. This is used for ornamenting wood, etc.

3.—Pulped Paper Molded Into Forms. —It possesses great strength and lightness. It may be rendered partially waterproof by the addition of sulphate of iron, quicklime and glue, or white of egg to the pulp; and incombustible by the addition of borax and phosphate of soda. The papier mache tea trays, waiters, snuff boxes, etc., are prepared by pasting or gluing sheets of paper togther, and submitting them to powerful pressure, by which the composition acquires the hardness of board when dry. Such articles are afterward japanned, and are then perfectly waterproof.

4.—A durable and inexpensive method of employing papier mache as a substitute for mattings, carpets, etc., is as follows: After the floor has been thoroughly cleaned, the holes and cracks are then filled with paper putty, made by soaking newspaper in a paste made of wheat flour, water, and ground alum; that is, to 1 lb. of such flour are added 3 qt. of water and a tablespoonful of ground alum, these being thoroughly mixed. With this paste the floor is uniformly coated, and upon this a thickness of manila or hardware paper is placed; or, if two layers are desired, a second covering of paste is spread on the first layer of manila paper, and then the second thickness of paper is put on, and the whole allowed to become perfectly dry; on this being accomplished, another surface of paste is added, succeeded by a layer of wall paper of any style or pattern desired. On the work becoming entirely dry, it is covered with two or more coats of sizing, made by dissolving ½ lb. of white glue in 2 qt. of hot water, and when this has dried, a coat of hard oil finish varnish.

5.—Paper is pulped in a mortar (or pulping engine) and mixed with ordinary glue size thinned somewhat with hot water. Remove the pulp and let it partially drain upon a linen-covered frame. Put a quantity of this into the mold under strong pressure, and let it remain until it becomes hard enough to handle. A counter mold is used in casting such thin sheets. Plaster molds are too fragile. Casts in type metal or fusible metal are much better.

6.—For papier mache furniture the following method of manufacture is followed: The pulp is prepared, consisting for the most part of waste papers broken up in the engine, and run into drainers. This half stuff is then taken and molded into the required form, and after drying is varnished and polished. Articles made in this way are termed papier mache, and very light and durable tables, chairs, trays, and numberless other articles of furniture, are produced at very small cost. The principal objection to this substance is that it has not the same power of retaining a firm hold of nails, screws, etc., which is possessed by wood, so that for articles requiring hinges, or other similar arrangements, it is not so suitable. It may be turned in a lathe or molded to any shape in the condition of pulp, so that it is very suitable for articles made in one piece only; it is also susceptible of a considerable amount of ornamentation by inlaying with mother-of-pearl and other substances, which is easily done when the article is in the damp, soft state.

7.—Articles, so named, are produced by pressing the pulp of paper between dies, or by pasting paper in sheets upon models. The articles, when dry, are varnished, japanned, and ornamented. By the first method a variety of cheap articles is manufactured in Paris; the materials for the pulp, viz., paper and paste, being supplied by the bill-stickers, whose bills, having served the purposes of advertisement, are pulled down and taken to the factory, mashed in water, and pressed in molds. The second method is the superior of the two, and is thus conducted at Birmingham: Paper of a porous texture, saturated with a solution of flour and glue, is applied to an iron, brass or copper mold, of somewhat smaller size than the object required; repeated layers of this paper are put on with glue, a drying heat of 100° F. being applied after every new coat. When a sufficient thickness is attained the shell is removed from the mold and planed and filed to shape. About 10 layers are used for ordinary tea trays, more or less for other articles, according to requirements. A stoving varnish mixed with lampblack is next laid on, and the article is stoved. Several coats of varnish are added, with a stoving after each (see *Japanning*). When sufficiently covered with this preparation the inequalities are removed with pumice-stone, and the artist applies the ornament in bronze powder, gold or color. Several coats of shellac varnish are then put on, and the article is stoved at a heat of 280° F. The surface is polished with rotten-stone and oil, and brought to a brilliant gloss by hand-rubbing.

8.—Papier mache used for decorative purposes is prepared by laying sheets of brown paper one over the other, with a coat of glue between every two layers. This mass of paper is pressed into a metal mold of the ornament required; the molded paper being trimmed to shape, a composition of the pulp of paper mixed with rosin and glue is put into a mold in a thin layer; the paper is again inserted and pressed upon the pulp composition, which adheres to it and produces a sharp, well defined ornament.

9.—Two modes of making articles of papier mache are adopted, either by gluing or pasting different thicknesses of paper together, or by mixing the substance of the paper into a pulp and pressing it into molds. The first mode is adopted principally for those articles, such as trays, in which a tolerably plain and flat surface is to be produced. Sheets of strong paper are glued together, and then so powerfully pressed that the different strata of paper become as one. Curvatures may be given while the material is damp, by the use of presses and molds. Articles such as snuff boxes are made by gluing pieces of paper cut to the size of the top, bottom and sides, one on another, round a frame or mold, which is afterward removed.

Articles made of pasteboard have a fine black polish imparted to them in the following manner: After being done over with a mixture of size and lampblack, they receive a coating of a peculiar varnish. Turpentine is boiled down until it becomes black, and three times as much amber in fine powder is sprinkled upon it, with the addition of spirit or oil of turpentine. When the amber is melted some sarcocolla and more spirit of turpentine are added, and the whole is well stirred. After being strained, this varnish is mixed with ivory-black and applied in a hot room, on the papier mache articles, which are then placed in a heated oven. Two or three coatings of the black varnish will produce a durable and glossy surface, impervious to water.

10.—Papier mache, properly so called, is that which is pressed into molds in the state of a pulp. This pulp is generally made of cuttings of coarse paper, boiled in water, and beaten in a mortar till they assume the consistency of a paste, which is boiled in a solution of gum arabic or of size to give it tenacity. The molds are carved in the usual way, and oiled, and the pulp is poured into them, a counter mold or core being employed to make the cast nothing more than a crust or shell, as in plaster casts. In some manufactories, instead of using cuttings of made paper, the pulp employed by the paper maker is, after some further treatment, poured into the molds to produce papier mache ornaments.

Papier mache has now, in some cases, superseded the carved and composition ornaments employed to decorate picture and glass frames; but it is in the ceilings and walls of rooms and the interiors of public buildings that papier mache is found most valuable. Plaster and composition ornaments are ponderous; carved ornaments are costly; but those of papier mache are light and of moderate price. Maps in relief are also occasionally made of papier mache. Paper roofs have been occasionally used. Sheets of stout paper are dipped in a mixture of tar and pitch, dried, nailed on in the manner of slates, and then tarred again; this roof is waterproof, but, unfortunately, very combustible.

Parchment Paper and Vegetable Parchment.

In the manufacture of parchment papers certain mixture proportions of water and acids, a definite temperature and duration of the mixing must not be neglected, the conversion occurring only under certain conditions. Gaines employs a mixture of 2 parts concentrated sulphuric acid and 1 part water; probably parts by volume are here indicated. According to Hofmann, the limits of dilution may be between ¼ volume and ½ volume of water to 1 volume of pure sulphuric acid. Dullo recommends 1,000 parts of sulphuric acid to 125 parts of water. If we mix 1 l. of sulphuric acid, or 1,834 grams, with 250 c. c. of water, or, what is the same thing, 1,000 grams of oil of vitriol with 136 grams of water, we obtain an acid of 1.754 specific gravity, or 63° Be. In the second mixing proportion, which is described by Hofmann as just admissible, 1 l. of sulphuric acid, or 1,834 grams, is mixed with 500 c. c. of water; or, what is the same thing, 1,000 grams of oil of vitriol with 273 grams of water; in this case, after cooling, the acid will have a specific gravity of 1.659, or 58° Be. If we take the mean between these two values, we shall have an acid of 60° Be., as made by chemical factories by evaporation in lead pans, proportionately cheaper than the concentrated acid can be applied, which probably is best to work with, and enables one to avoid the exceedingly troublesome mixing of large quantities of acid with water. The temperature of the acid should not be above 60° F.; a somewhat lower temperature will do no harm, whereas at a higher heat the paper may be dissolved into a slimy mass. The period of contact between paper and acid must not be long; it must be gauged to some extent by the thickness of the paper. For thin papers 5 seconds suffices; even the thickest do not require more than 20 seconds. Immediately after the paper has been removed from the acid it must be put in water, and washed, with constantly fresh water, until it no longer shows a trace of acid. To be certain that all acid has been neutralized, the paper may be finally passed through a weakly alkaline bath and then washed again. In wholesale manufacture, as in a factory, the unsized, endless web of paper, wound as a reel, is passed through a lead-lined vessel, about a lead-covered roller, submerged in the acid. After emerging from the acid it is passed between a pair of rollers, which, by moderate pressure, express the superfluous acid, which flows back into the first receptacle. From here it is passed in the same manner through several vessels containing water, into the last of which a continuous supply of fresh water is pouring. To remove the last trace of free acid it is then passed through a receptacle the water in which, by means of an addition of ammonia renewed from time to time, is kept always weakly alkaline. It is finally passed again through clean water. The more thorough the washing before it enters the alkali bath, the less ammonia will be used; it is therefore to the interest of the manufacturer to make the washing as perfect as possible, so that the ammonia bath may be a more useful than necessary precaution. After the last washing the paper passes between a pair of felted rollers, in order to be freed as far as possible from water, then, kept tight by drying felts, between the drying cylinders, and before it is perfectly dry, through a calendering press, the rolls of which are heated by steam. During the drying care must be taken to maintain high tension in the breadth, parchment paper wrinkling at this stage to a much greater extent than ordinary paper, and it may acquire an uneven surface, if this is not obviated by stretching. If it is desired to produce particularly thick parchment paper, two paper webs are carried separately into the acid bath, but on leaving the acid, caused to pass between the first pair of rolls, before they enter the water, they are passed together between the compression rolls. The two sheets will then adhere so closely together that they can by no means be separated.

Coloring.—1.—Prepare the parchment with pounce, as for writing. Use ordinary water colors mixed with alum water. The alum makes the parchment take the paints readily. Go over the part to be painted quickly with the color. It is best to have the parchment on a slanting surface, as then the water does not soak in so much. Parchment does not cockle unless wet through.

2.—Green.—Boil 8 parts of cream of tartar and 30 parts of crystallized verdigris in 500 parts of water; when this solution is cold pour into it 4 parts nitric acid. Moisten the parchment with a brush, and then apply the above liquid evenly over its surface. The necessary surface finish is given with white of egg, or mucilage of gum arabic.

3.—When the plans on deeds (parchment) are colored so that the coloring is a flat wash of water color over a large surface, a little fine whiting should be rubbed over the parchment, and the surface dusted over; the color can then be laid on evenly, provided the colorist has had sufficient previous practice in coloring ordinary drawings. If the parchment has been handled much, a little oxgall mixed with the color will make it go on more evenly. Very old or badly prepared parchment may show spots where the color goes through. The skin should be left lying flat after coloring, and not dried before a fire. Do not attempt to color on parchment until sufficient practice has been obtained to do perfect work on drawing paper. Some draughtsmen cannot color without causing even the paper to cockle.

Drumhead Parchment.—The following is the best way to preserve and clean a goatskin that is to be used for a drumhead. The skin should first be soaked for several days in a solution of lime and water, and the hair removed by shaving with a sharp knife. The skin should then be nailed tightly, flesh side out, to a board, and the fleshy and rough parts removed; this may be done with a close-set spokeshave and a steel scraper. The skin should next be sprinkled with chalk and rubbed down with a smooth piece of pumice-stone until perfectly smooth, the refuse being washed off; it is then allowed to dry. It may be again rubbed down with smooth pumice-stone, after which it should be taken off the board and again nailed on, but with the hair side out, any roughness on that side being also smoothed with pumice-stone. The skin should finally be removed and worked backward and forward over a round piece of wood till it becomes supple and smooth.

Fastening Parchment to Polished Surfaces.—To fasten parchment paper to polished surfaces employ the following cement, which, when made, should be kept in well corked bottles: Macerate in a small quantity of water, in separate vessels, 4 oz. of gum arabic and 1 oz. of gum tragacanth, and well stir the latter, when it gets swollen and softened, until it is homogeneous throughout. Mix the two gums, and filter the whole through linen, and then add slightly more than 1 gill of glycerine in which 0.9 oz. of thymol has been dissolved. Add water to bring the bulk of the whole up to about 1¾ pt.

Imitation Parchment Paper.—Most of the artificial or imitation parchment papers are made from sulphite cellulose, or pulp, with additions of glue and sulphate of alumina, the sulphite cellulose made according to Mitcherlisch's process, owing to its long, strong fibers, being best adapted for the purpose. Other manufacturers use a mixture of sulphite of cellulose and straw pulp, also sized; others, again, use sulphite cellulose without size, but add a little sulphuric acid in the Holland engine. The following recipes have been successfully employed in practice:

1.—Sulphite cellulose, 60%; soda cellulose, 25%; wood pulp, 15%. Fully sized, 4 parts size, 5 parts sulphate of alumina to 100 parts of dry stuff. The paper is admittedly good, but not of the best quality.

2.—Sulphite cellulose, 100%, fully sized; glue and sulphate of alumina, 5 parts each to 100 parts of dry stuff. The result is the ordinary parchment paper imitation.

3.—Sulphite cellulose II, 100%; 2 parts of sulphuric acid diluted with water, are added to each 100 parts of dry stuff in the Holland engine. The paper made from second quality sulphite cellulose is of coarse appearance, but is very much like parchment.

4.—Sulphite cellulose, 60%; straw pulp, 40%; size, 4 parts; sulphate of alumina, 4 parts to 100 parts of dry stuff. A very bright-colored paper, clearly translucent.

5.—Sulphite cellulose, 60%; straw pulp, 40%; size, 4 parts; sulphate of alumina, 3 parts to 100 parts of dry stuff.

6.—Sulphite cellulose, 60%; straw pulp, 40%; size, 3 parts; sulphate of alumina, 3 parts to 100 parts of dry stuff.

7.—Sulphite cellulose, 70%; straw pulp, 30%; size, 3½ parts; sulphate of alumina, 3 parts to 100 parts of dry stuff.

8.—Sulphite cellulose, 100%; size, 5 parts; sulphate of alumina, 5 parts; stearine, 2 parts to 100 parts of dry stuff. The paper is good, and more greasily brilliant than the others. The stearine, in No. VIII, is to be chopped into small pieces, mixed with warm water, and in this form added to the stuff in the Holland engine. According to experience, the paper made according to No. VIII, with the addition of stearine, has been found best for the different purposes.

9.—Of the greatest importance in the manufacture of artificial parchment paper is the grinding in the Holland engine. The stuff must be ground long, to a smeary paste, and before discharging into the tub thoroughly beaten up—after elevating the engine roller—for ¼ to ½ hour. On the machine it must be moderately shaken and heavily pressed. No worn-out felts must be used, and the drying felts must be tightly stretched to prevent, as far as possible, any formation of blisters in the paper; the drying must also proceed as slowly as possible, otherwise the paper will readily shrink or wrinkle. It is advisable, at the first cylinder, or, better still, at the first and second, to allow on each side of the paper web a strip of paper 4 centimeters (about 1.6 in.) wide, to run completely around the cylinder, on which the two edges of the wet paper web can lie. This prevents too rapid a drying at the edges, and a consequent blistering of the entire paper web. The tensions in the machine must also be kept tight throughout.

Liquid Parchment.—According to Dr. Hofmann, a fluid by this name, consisting of gutta percha, softened and soaked in ether, is especially adapted for forming a coating for pictures and cards, it permitting the removal of dirt with a moist rag. Pencil and crayon drawings may be rendered ineffaceable by sprinkling with this liquid by means of an atomizer, an exceedingly delicate film remaining on the evaporation of the ether.

Paper, Parchmentized.—1. — Paper is parchmentized by passing it through a bath of weak sulphuric acid. The acid in the paper must afterward be neutralized by passing the paper through an alkaline bath or through water. Adding the acid to the pulp in the heating process would not have the same effect as the acid bath, because the acid must act on the surface of the paper.

2.—Strong unsized paper is immersed for a few seconds in oil of vitriol diluted with half its volume of water. It is then washed in pure water or weak ammonia water. The acid solution must not be warmer than the surrounding atmosphere.

Pasting.—Moisten the surface of that part of the paper which is to be joined with alcohol or brandy, then apply the glue or paste; gum arabic will not answer. A firm joint may be made by inserting a piece of very thin paper between the surfaces of the parchment paper.

Smoothing.—To smooth parchment which has become wrinkled, place the parchment face down upon clean blotting paper. Beat up to a clear froth, with a few drops of clove oil, the whites of several fresh eggs, and with the fingers spread this over the back of the sheet, and rub it in until the parchment becomes smooth and yielding. Then spread it out as smooth as possible, cover with oil silk, and press for a day. Then remove the silk and cover with a linen cloth, and press with a warm iron.

Scaling of White Pigment, To Prevent.—Reduce to powder, and dissolve quickly in cold water, a quantity of gum tragacanth. There must be sufficient water to give the diluted gum the consistency of a jelly. Mix with this your pigments (sulphate of baryta), and, after finishing the work, spray with a little naphtha in which has been digested for some time a quantity of caoutchouc. The naphtha will soon evaporate, leaving behind the caoutchouc as an extremely thin and adhesive, but perfectly transparent film.

Transparent.—Soak a thin skin of parchment in a strong lye of wood ashes, often wringing it out, until you find it becomes transparent; then strain it on a frame and let dry. This will be much improved if, after it is dry, you give it a coat, on both sides, of clear mastic varnish, diluted with spirits of turpentine.

Vegetable Parchment.—v.—Is made by dipping ordinary paper for a few seconds into a solution containing 1 part water to 6 parts sulphuric acid, then washing it carefully to remove every trace of acid.

2.—To Prepare for Writing and Drawing.—Ordinary vegetable parchment is not suitable for writing or drawing, since India and other inks blur on it. This evil is obviated by the following process:

The parchment is saturated with a glycerine solution, and in certain cases with an alum solution, next dried somewhat, and then treated with size. If parchment cut in sheets is to be sized, the sheets, after having been dipped into the glycerine solution, or the alum solution, are stretched on frames, dried a little and next dipped in diluted animal or vegetable glue, or painted or sprinkled with it. Among the vegetable sizes, the so-called rosin size is especially suited, but the glue made from cellulose wastelies, or else starch, may also be employed.

But if the parchment is to be sized at or immediately after the production, without having been cut into sheets, it is drawn through the glycerine solution after leaving the dried bath and after having been washed and pre-dried, and is, after a suitable desiccation, slowly passed through the size, whereupon it is dried on cylinders or in any other manner, and finally glazed between zinc plates or in calenders, or similarly.

By the treatment of glycerine or alum solution the parchment is rendered pliant and loosened, thus being enabled to take up and bind the size better.

In order to give the parchment a white color and take away its glossy transparency, the size is mixed with alumina. Likewise, any desired color may be imparted to the parchment by the addition of corresponding other pigments.

Passe-Partout Framing.

In order to make passe-partout frames properly a board should be prepared as follows: Select a smooth board without warp, 2 or 3 in. longer and wider than the largest frame desired. Finish the two longer sides by nailing on the edge a narrow strip, which should project above the working side of the board not more than 1-16 in. This will be found sufficient to prevent the glass used from slipping off the board, and will provide a resting shoulder against which the glass may be pressed during the making of the frame. On one side of the board draw a line at a distance of ½ in. from the projecting edge; at the other side of the board a line should be drawn ¼ in. from the opposite projecting edge. These lines should be marked plainly and accurately, as they form the guide lines upon which the binding strips are placed, and if they vary in distance the binding strips cannot be accurately placed in position.

The binding strips should be selected from some strong paper or gummed binding cloth that will either harmonize with the print to be framed, or with the paper which may be used as a mat to give the print a sufficient margin. For this purpose use the lighter grades of cover papers which are cut into strips by the use of the common yardstick and a very sharp knife. A smooth sheet of binder's board underneath the cover paper will render the cutting of the binding strips much easier. The strips should be 2 in. wide if a large size frame (11 x 14) is to be made; for smaller sizes a narrower strip may be used, but the wide strip is much easier to handle, and gives added strength to the frame.

For backing, the ordinary strawboard is all that is required. This can often be found among the waste pasteboard boxes in the home. In fact, parts of old boxes are preferable to new stock bought at the paper warehouse, for the reason that new stock is rarely thoroughly dried, and instances have been known where the drying of the backing board has caused such a warping tendency that the cover glass has been broken. The backing boards should be cut to the exact size of the glass which is to be used in framing. Any deviation in the measurement of the glass and the backing board will result in an unsightly frame that the most skilful worker cannot avoid.

The hangers for the frame can usually be secured at stores where picture frames are made. If these are not procurable, the small brass rings can be purchased at hardware stores, and narrow strips of tin can be used to form the loops on which the rings are fashioned. These strips should be fully 2 in. in length, and should be threaded through the rings, then doubled, so that the ring will hang midway between the ends, which are passed through narrow slits in the backing board, and then spread in the manner of a paper fastener, and hammered down until they are perfectly flat. To make the frame proceed as follows: Place the glass upon the board so that it will be in perfect register with the projecting edge. The binding strips should have been previously moistened and the surplus water blotted off. With a bristle brush apply Higgins' paste, or some similar mountant, to one of the binding strips and work the paste in thoroughly, so that the strip will be well saturated with the paste, so well worked in that it will not ooze out upon the glass. This precaution will not be necessary if a prepared gum strip be used. The binding strip, which should be of the exact length of the side of the glass to be covered, should now be laid upon the glass, using the line described above as a guide. Press the strip gently with the fingers until partial adhesion results, and then rub in perfect contact with a soft cloth. The glass should be then turned and the opposite side covered in the same manner.

In binding the last two sides, tiny strips of paper should be placed on the edges of the binding strips already in position, so that the paste from the remaining strips will not soil the corners, which are to be mitered. In finishing the last sides the outer strips should be mitered by the use of a miter pattern made from a thin piece of wood or cardboard. This pattern is laid upon the binding strips after they are firmly placed in position, and the outer strip cut with a very sharp knife. The corners, with the underlying protecting paper, can then be removed and the last binding strips rubbed into thorough contact.

The cover glass is now ready for the final binding with the print and the backing board. The glass should be removed from the board and a clean paper spread upon the board, upon which the glass is placed face downward. Upon this lay the print, with its mat—if any—face downward; place upon this the backing board, taking care that the hangers are in the right position, or the framed print may be found, when finished, to be arranged for hanging in a reversed position. Great care should be taken to see that the print, the mat and the backing board are in accurate register. Paste should then be liberally applied to the projecting edge of the binding strip on the right-hand side, and when thoroughly pliable the strip should be closely drawn over the edges of the frame, on to the back of the backing board, and then rubbed in contact with the soft cloth. The frame should then be turned so that the left-hand side occupies the place of the right side, now completed, and this side and the ends treated in the same manner.

Patent Drawings.

The size of a sheet on which a drawing is made must be exactly 10 × 15 in. One inch from its edges a single marginal line is to be drawn, leaving the sight precisely 8 × 13 in. Within this margin all work and signatures must be included. One of the shorter sides of the sheet is regarded as its top, and measuring downwardly from the marginal line, a space of not less than 1¼ in. is to be left blank for the heading of title, name, number and date. Patent drawings are very difficult to make, and those not prepared under the direction of competent attorneys are often rejected by the Patent Office as informal.

Picture Frames.

Preparation and Gilding.—For the following description of picture frame gilding we acknowledge our indebtedness to "Workshop Receipts," Series 1: Suppose that we have a plain picture frame; it is made by the joiner in a 12-foot length of molding, and in that state it passes into the hands of the gilder. He first gives it a priming of hot size and whiting, called thin white. The whiting employed by the gilder is not the same as that used for domestic purposes, but is finer and more free from grit. The size employed is prepared by the gilder from parchment cuttings or glove cuttings. The cuttings are well washed in water and then boiled in a certain quantity of clean water until the latter has a particular degree of adhesiveness, which can only be determined by experience; this is then poured off into a clean, dry vessel and allowed to cool. When about to be used, the grease at the top and the sediment at the bottom are cut off with a knife, the size is melted in an earthen pipkin, and a small quantity of finely powdered whiting is mixed with it. When the thin white is dry all holes and irregularities in the molding are filled up with putty. This putty is not the same as that employed by the glazier, but consists of whiting and size mixed to the consistency of putty. When the puttying is dry a coating of thick white is laid on with a brush. This thick white differs from the thin white only in having a larger proportion of dry whiting mixed with a given amount of size, the consistency attained being rather thicker than that of oil paint. When the first thick white is dry another is laid on in the same manner, and, similarly, a third, a fourth and a fifth are laid on, all about equal in thickness, and each one being perfectly dry before the next is applied. As in laying on this large body of thick white, the fine squares, hollows and fillets would be liable to be stopped up and lose all their clearness and sharpness, opening tools, consisting of crooks, chisels and gouges, are drawn along the fine parts of the molding, while the thick white is still wet, by which means the forms of the various moldings are retained. This is still better effected by the double opening white, which consists of 2 thick whites, the one laid on almost immediately after the other, by which a thick soft coating covers the molding. Hard stones, shaped to the forms of the moldings, together with the opening tools before described, are to be worked over every part of the molding, by which asperities are smoothed down, depressions filled up and edges brought up nearly to their required sharpness. In this state the whiting on the molding is from 1-16 to 1-12 of an inch in thickness. It is now trimmed at the back and edges by cutting off the whiting which had flowed over from the front, which prepares it for the process of smoothing. This is done by means of pieces of pumice and other stones, shaped so as to fit the various parts of the molding. A sponge or soft brush is used to wet the molding, and the stone which is to be used, being likewise wetted, is rubbed or worked to and fro along the molding until that part is perfectly smooth. Another stone, fitting a different part, is then used in the same way, and so on until every part of the length and breadth of the molding has been worked over by the stones. The molding, if the smoothing has been properly performed, now presents a smoothness of surface exceeding and a keenness of the edge nearly equaling that which the molding presented when it left the hands of the joiner, but this must be attained without rubbing off too much of the whiting, since the whole beauty of the frame mainly depends on having a sufficient body or foundation of whiting. The brilliant burnishing on frames is, in a peculiar degree, dependent on the whiting which is first laid on the wood, and which, if deficient in quantity, cannot be adequately replaced by other means. The molding being thoroughly dried from the effects of the smoothing, is rubbed down with glass paper or sand paper, to take off any little asperities that may remain, and to make the whole perfectly smooth. It is now ready for the process of gold sizing. The burnish gold size used in this process is composed of ingredients exceedingly opposite in their nature, such as pipe clay, red chalk, black lead, suet and bullock's blood. This diversity of ingredients is intended to produce different effects; one substance helps to give a brilliancy to the burnish, another to the mellowness and smoothness and so on. The form in which the gilder purchases his burnish gold size is that of a solid rather softer than butter. He first takes some very clear size, boiled purposely to a smaller degree of strength than the size for thick white, or, if already boiled, weakened by water. This size he melts in an earthen pipkin, but without making it very hot, and then mixes the gold size with the melted size by means of a clean brush, much in the same manner as a painter mixes his oil paint; the consistency to be about equal to that of cream. It is a source of some confusion that the same term, burnish gold size, is applied to this creamy liquid as to the thicker substance from which it is prepared; it is necessary to say mixed gold size or unmixed gold size, in order to indicate which is meant. This gold size is laid on the molding either with a very soft hog's-hair brush or by a large camel's-hair pencil fixed in a swan's quill. The gold size must be barely warm and must be laid on with great care so as to leave it equally thick in every part, and obliterate the marks of the brush; upon the due observance of a medium between hot and cold, strong and weak and thick and thin in the gold size laid on depends much of the beauty of the molding when gilt. From 4 to 8 coats of this gold size are laid on the molding, each one being perfectly dried before the next is applied. A soft, partially worn piece of glass paper is occasionally used to take off any little roughness that may exist. When a sufficient body of gold size is laid on it is carefully washed with clean water, a soft sponge and a piece of linen rag. This must be done with attention to the soft edges, which are very likely to lose the whole of their gold size if care is not used; the object is to produce a perfectly smooth surface, especially in those parts which are to be matt gold.

The test of good work is to produce the smoothest surface with the least loss of gold size. When the molding is partially dry from this process, the matt parts are polished with a piece of wooden cloth, and the parts to be burnished receive another coating of gold size, laid on as smoothly as possible. The piece of molding which is to be gilt is laid along the bench with one end higher than the other, and as the width of the molding is broken up into several divisions, such as hollows and squares, it would be impossible to make a leaf of gold bend into all the various parts without breaking. The gilder learns by experience how many separate lays, as they are called, of gold will be required to cover the width of the molding without the breaking of the gold into irregular fractures called spider legs. In general a deep hollow, or a depressed square, cannot be gilt at one lay, but must be covered with 2 strips of gold laid side by side and meeting at the center of the depression. When the gilder has made his decision as to the number of lays that will be required, he selects one lay and proceeds with it through the whole length of the molding before he begins another portion of the width. If the necessary lay be about ¾ or ⅞ of an inch in width, he cuts the leaf which is spread out on his cushion into 4 strips; if it be about 1 inch in width, he cuts the leaf into 3, regulating the division of the leaf of gold according to the width of the lay. It is not often that a larger piece than ½ a leaf is used at once. The gilder has at hand a pan with clean water and 2 or 3 camel's-hair pencils of different sizes. With one of these pencils he wets a few inches of that part of the molding which is to form his first lay, taking care not to wet much beyond that lay. The water is to be allowed to remain pretty full on the surface, after some of it has been imbibed by the gold size. The gilder then takes his tip in his right hand and lays it on the slip or gold, which slightly adheres to the hairs; whence he places it on the molding, with particular attention to straightness of direction. It frequently happens that the hairs of the tip will not take up the gold; in such case it is usual to rub the hairs between the cheek and the palm of the hand, by which their power of taking up the gold is increased. When the gold is laid on it is blown forcibly to expel as much of the water as possible from beneath it, the dry camel's-hair pencil being used to press down any parts which fail to adhere. Another portion is then wetted and another piece laid on, lapping about ⅛ of an inch over the end of the former piece. Thus the gilder proceeds, piece after piece, until the one lay is carried down the whole length of the molding; he then proceeds with another lay joining the former. In doing this he has to observe that the water must be made to flow a little over the edge of the former lay; but not so as to wash it up or break away the edge: the second lay must lap a little over the first, and therefore the water must likewise extend over the first lay. Thus he proceeds with all the lays into which he has found it necessary to divide the width of the molding; every piece, lengthwise, lapping over the piece previously put on and every lay lapping over the previous lay. The molding is then set aside to dry. There is a particular state or degree of dryness, known only by experience, in which the molding is in a fit state for burnishing.

The burnishers used by the gilder are either of flint or agate, generally the former. The steel burnishers employed by the jeweler would not do for the gilder. Burnishers of different forms and sizes must be employed, in order to adapt them to the part of the work which is being burnished. They are generally crooked or curved near the end. When the burnishing is done, those parts which have not been burnished are weak sized—that is, they are wetted with water in which a very little clear piece of size has been melted; this helps to secure the gold. When dry, the gold is wiped carefully with a piece of soft cotton wool, to remove rough or ragged edges of gold, and there are now visible a number of little breaks, holes and faulty places in the gilding, arising from the impossibility of laying on the gold quite soundly and perfectly.

These defective parts are repaired by the process of faulting, which consists of cutting up a leaf of gold into small pieces and laying them on the faulty places, previously wetted with a camel's-hair pencil. If the defective part is on the burnish, it is necessary to be careful not to wet any part but what is to be covered by the gold, as it will stain the burnished gold. When the faulting is dry, the gold is again carefully wiped and finally wetted with finishing size. This is clear size of a certain degree of strength, laid on the matt parts with a pencil, and completes the process of gilding.

When a glass frame is to be gilt, the joiner's work is generally quite complete before the gilder begins, and great care is required in whiting such frames, to prevent filling up the corners with whiting and giving them a clumsy appearance. For this purpose modeling tools, such as chisels, gouges and crooks, are used to clear out the corners from time to time and preserve the original sharpness and clearness of the several parts.

Burnished Gilt Frames.—When new burnished gilding requires varnishing, white hard spirit varnish is used or yellow gold lacquer. Old burnished work must be cleaned with great care. First remove the dust with a badger's-hair brush; afterward clean the gilding by passing a clean sponge, dipped in gin and water, lightly over the surface, wiping off the moisture with a very soft dry sponge or silk handkerchief; then apply the varnish and finish.

Cleaning Gilt Frames.—Gilt frames may be cleaned by simply washing them with a small sponge, wet with urine, hot spirits of wine or oil of turpentine, not too wet, but sufficiently to take off the dirt and fly marks. They should not be afterward wiped, but left to dry of themselves.

Composition for Molding.—1.—The following is used by gilders: Mix glue, 14 lb.; rosin, 7 lb.; pitch, ½ lb.; linseed oil, 2½ pt.; water, 5 pt. more or less according to the quantity required. Boil the whole together, well stirring until dissolved, add as much whiting as will render it of a hard consistency, then press it into mold, which has been previously oiled with sweet oil. No more should be mixed than can be used before it becomes sensibly hard, as it will require steaming before it can be used again.

2.—Make a very clear glue with 3 parts of Flanders glue and 1 part of isinglass by dissolving the two kinds separately in a large quantity of water, and mix them together, after they have been strained through a piece of fine linen to separate the parts which could not be dissolved. The quantity of water cannot be fixed, because all kinds of glue are not homogeneous, so that some require more than others. The proper strength may be found by suffering the glue to become perfectly cold; it must then barely form a jelly. The glue is to be gently heated, then mixed with saw dust sifted through a fine sieve. The molds are then to be oiled with nut oil and the glue pressed into the mold, covered with weighted board and then set to dry near a stove. When the casting is dry it is to be trimmed.

Regilding Frames.—Take a sponge and some clean water and wash the frame well, then let it dry; procure some water gold size; make some thin size from dry hide or parchment, mix enough warm with the gold size to enable you to work it on the frame with a camel's-hair brush; give it 2 coats. When dry rub it over with a piece of fine sand paper; it will then be ready for gilding. When the frame is covered, rest it on its edge to drain; when perfectly dry dip a pencil into water and wipe the gold over with it; it will take the particles of gold off and make it appear solid. For any parts not covered take bits of leaf with a dry pencil and lay on as before, then give the whole a coat of clear parchment size. Brush the back edges over with ocher and the frame is then ready.

Plaster Casting.

1.—The model (of clay or otherwise) is first covered with a layer of good plaster of paris, mixed, or "gauged," as plasterers call it, to the consistency of batter, and colored with a little red or yellow ocher. This layer should average about ¼ in. thick. It is best applied with the pewter or metal spoon used to mix the plaster with. The plaster is mixed in a basin half full of water, into which it is sprinkled by the hand, as oatmeal is sprinkled in making stirabout; when the plaster reaches the surface of the water it is about sufficient, but experience soon teaches the right proportion. The mixed plaster can be jerked by a dexterous twist of the spoon into the deep undercut places, and care must be taken not to inclose bubbles of air. A practical molder would place the clay slab in a vertical position, as he would see the process of his work better. A large model would require several mixings of plaster, as when the plaster begins to set or harden it is useless for molding. When the first colored coat of plaster is hardened a wash of clay water should be applied nearly all over it, and the second coating, which may be of coarser stuff, put on to the thickness of about 1 in. If the mold is very large, some strips of iron nail rod, ¼ in. square, may be imbedded in the back of the mold to prevent warping. When the mold is set hard it must be turned over and the clay picked out. If the work has been modeled on a board or slate, or best of all, on a plaster slab, it may be necessary to pass a wire between the clay and the board to separate them. When the mold has been well cleaned and washed with a soft brush it should be soaked in a tub of water until quite saturated through and through, drained, but not wiped, and a sufficient quantity of superfine plaster, carefully mixed, poured into it, and, by moving the mold about, carefully distributed all over. This may be backed with coarser plaster and strengthened with iron rods, which in this case should be painted or coated with a varnish of rosin and tallow. When the cast is set hard the most difficult part, called "knocking out," begins. A light mallet and a carpenter's firmer chisel, by a few dexterous strokes applied upon the edge, will separate the coarse outer backing of the mold, prevented by the wash of clay water from adhering to the first colored layer. The cast should then be placed upon a soft elastic bed—an empty sack folded is as good as any—and by gentle taps, holding the chisel perpendicularly, or nearly so, to the face of the work, the colored plaster may be snapped off, sometimes in large, sometimes in minute pieces, the color preventing the operator chipping away the best part of his work, which may happen when mold and cast are of one color. A chisel 1 in. or more broad may be used for the first rough work; smaller will be required for delicate parts.

A figure in the round may be molded by the same process, but the mold must be in 2 parts. A strip of clay 1 in. or so wide must be fixed all around the clay figure, to be removed when the first half of the mold is done. The edge of the first half must have sunk holes, made by any convenient steel modeling tool, to insure the fitting of the two halves in the mold. Projecting limbs must be cut off with a fine wire and cast separately. If an iron support enters the back of the model a little clay must be put round it, close to the model, to enable the iron to be drawn through the mold, and the hole in the mold stopped up with plaster. The two parts, carefully saturated and bound together, may be about half filled with well-mixed superfine plaster, as thick as cream, which, by carefully turning and inclining the mold, can be made to cover the whole of the mold, leaving a large hollow to be filled with a coarser plaster, in which a painted iron rod may be inserted. Good plaster smells sweet, sets in 10 to 20 minutes as hard and as crisp as loaf sugar. Bad plaster smells of sulphur and never sets hard. Beginners must make sure of their materials, and even then should try their hands on unimportant work.

Small reliefs may be molded in wax. A border of clay or strips of wood a little higher than the highest part of the model must be fixed all round, and melted beeswax with a little rosin and tallow added, poured over the clay. When the wax is cold and the clay well washed out superfine plaster can be poured in as into a plaster mold. The wax is afterward melted off or softened before a fire and peeled off, to serve again as often as you please.

2.—In the first place, use the finest and purest plaster of paris obtainable. When filling a mold, learn to beat up the requisite quantity of cream quickly and with care to avoid making it too thick. In pouring this in use a good camel's-hair brush to displace air bubbles; a mere surface cover of this thin cream is all that is requisite. While doing this have ready the thicker plaster, of the consistency of light syrup, and fill up the mold at once. In about 20 minutes you can open the mold, if your plaster is pure and has been properly mixed. If you do not put too much oil on the object to be molded, and have used your brush properly, you will find clear, sharp molds.

3.—*Bronzing Plaster Cast.*—a.—Coat the figure with isinglass size until the surface continues in a moist state and will absorb no more; then touch it over lightly and sparingly with gold size and put it away in a clean dry place for 48 hours. Touch the figure all over with bronze powder, and after the lapse of 24 hours brush off all the loose powder and particularly from the projecting parts of the figure.

b.—The following is given as a process used in France for this purpose. Linseed oil soap is made by saponifying the oil with caustic soda and precipitating the soap with salt. It is separated, dissolved in rain water and a mixture in solution of 4 parts blue vitriol and 1 part copperas is added as long as a precipitate forms. This is filtered out, washed and dried and 8¾ oz. are applied with 1 lb. quick-drying varnish and 5¼ oz. white wax. This is applied to the surface previously heated and is baked in if necessary. The high parts are touched up with a bronze powder. As a simpler process shellac the bust and then gild it with bronze powder and varnish. The varnish is sold with the powder. See also No. 23 below.

c.—Plaster-of-paris statuettes, models, etc., are bronzed in the following manner: Prepare a soap from linseed oil boiled with caustic soda lye, to which add a solution of common salt, and concentrate it by boiling till it becomes somewhat granular upon the surface; it is then strained through a linen cloth, and what passes through is diluted with boiling water and again filtered. Dissolve 4 parts blue vitriol and 1 part copperas separately in hot water and add this solution to the solution of soap as long as it occasions any precipitate. This flocculent precipitate is a combination of the oxides of copper and iron with the margaric acid of the soap, the former giving a green and the latter a reddish brown color, the combination of the two resembling that greenish rust which is characteristic of ancient bronzes. When the precipitate is completely separated a fresh portion of the vitriol solution is to be poured upon it in a copper pan and boiled in order to wash it. After some time the liquid is poured off and the soap washed with warm and afterward with cold water, pressed in a linen bag, drained and dried, when it is ready for use in the following manner: 3 lb. of pure linseed oil are boiled with 12 lb. of finely powdered litharge, and the mixture is strained through a canvas cloth and permitted to stand in a warm place until it becomes clear. 15 oz. of this, 12 oz. of the above described soap and 5 oz. of fine white wax are melted together at a gentle heat in a porcelain basin by means of a water bath. The mixture must be kept some time in a molten state, to expel any moisture which it may contain. It is then applied by means of a paint brush to the surface of the gypsum, which is heated to the temperature of about 200° F. After exposure to air for a few days the surface is rubbed with cotton wool or a fine rag and variegated with a few streaks of metal powder or shell gold. Small objects may be dipped in the melted mixture and then exposed to the heat of the fire until thoroughly penetrated and evenly coated with it.

4.—*Carved Articles.*—If the objects are cut conically they are simply pressed into a lump of soft clay; then paint the mold thus produced with linseed oil and pour in the plaster of paris. For complicated objects, such as animal heads, deepened reliefs, etc., glue molds are employed. Prepare a box just large enough to receive the model. Boil good joiner's glue in sufficient quantity, and after the model (which has been thoroughly coated with shellac, and after this is dry with linseed oil) has been laid in the box, pour the liquid glue into the box. After a few hours the glue is sufficiently dry so that the model can be taken out. Now coat the glue mold all over with linseed oil and pour in the gypsum. In this manner very good impressions are obtained at a comparatively slight expense. The molding glue can be used over again at any time.

5.—*Hardening Plaster Casts.*—a.—The following is one way of treating them; First dry the cast in an oven heated to about the temperature used for baking bread. When the cast has cooled down so that it may be handled without burning the hands immerse it in a strong aqueous solution of alum and leave it there until crystals begin to form on the surface, then remove and wipe dry. Any adherent crystals may be removed with a wet rag. Now return the cast to the oven and heat, at a temperature of about 140° F., until thoroughly dry. Remove and immerse in a bath of boiled linseed oil, cut with a little oil of turpentine. Let remain a few minutes, then remove, let the surplus oil drain back into the bath and stand aside in a warm place to let the oil become "tacky," then apply bronze powder.

b.—A few coats of a hot and saturated solution of borax, alum or similar substances are applied with a brush until the surface has the desired hardness. Two coats will generally answer, but occasionally as many as 5 or 6 may be necessary. A few (generally 2) coats of a hot saturated solution of chloride of barium and a few coats of soap water are then applied with a brush, and the surplus soap is washed off until the clear water forms beads on the surface of the cast.

These operations can be performed in a few hours and produce a hard surface consisting of substances insoluble in water and which will prevent the appearance of yellow spots, for the neutral salts that have been employed will prevent any action of the gypsum on the iron contained in the same. Different neutral salts may be used, and the operations may be performed in the reverse order. Instead of chloride of barium, other barium, strontium or calcium salts, that will produce an insoluble precipitate and will not produce oxide of iron, may be used.

c.—Glycerine is said to be a good coating for the interior, but lard and oil is most commonly used. Plaster casts immersed in a hot solution of glue long enough to be well saturated will bear a nail driven in without cracking.

d.—The articles made from crude plaster are heated to 212 to 228° F., put first in concentrated solution of calcium chloride, then in a hot, concentrated solution of sulphate of magnesia and finally then laid in water. These operations are repeated several times (the temperature being, if desired, increased to 212° F.). After impregnation, the pieces should be treated alternately with glue and tannin solutions, each time from 1 to 4 days, finally dried in a drying room at a depressing temperature. For colored marble add to the chloride of calcium solution such metallic chlorides as will produce, with the subsequent treatment with metallic salts, colored, insoluble deposits.

6.—*Life Casting.*—Casting from life is very unpleasant for the person operated upon, and especially when the face is molded the pain is considerable. The face is first greased well with vaseline, the eyelashes and eyebrows being well buried in pomade or clay and the small hairs well smoothed down. Whiskers, etc., should be well coated with clay. Quills are inserted in the nostrils for respiration. Then when the patient is lying in a recumbent position the plaster is laid on. The patient must not move or laugh or speak until the plaster is set. The plaster is mixed with warm water, as the plaster sets better than with cold water. When the cast is sufficiently set, it is removed. This is the painful part of the operation. A hand can be done by thrusting it in a basin of plaster, then placing it on a towel in desired position. As the plaster sets, lay a strong thread on the wet plaster along the hand down the middle finger. A second thread may be laid from the wrist to the thumb. The object of these threads is to make divisions in the mold and thus enable the hand to be withdrawn. Now lay on the plaster over the whole to a sufficient thickness. When it is nearly set (still soft and wet) take the ends of the threads, and by jerking them sharply through the plaster, sections are made in the mold. In a few minutes the plaster is hard and the mold may be burst asunder at the divisions cut by the thread and the hand released. Fractures which will probably occur in thin parts of the mold must be cemented carefully in their places after they are dry by a solution of shellac in alcohol. Limbs and even the entire figure can be molded in this manner. Professional molders should be employed in taking casts of deceased persons.

7.—*Marbling Plastic Figures.*—Dissolve 1 oz. of pure curd soap grated in water and add 1 oz. of white wax, cut in thin slices. When the whole is incorporated it is fit for use. Having dried the figure before the fire, suspend it by a string and dip it in the mixture; when it has absorbed the varnish dip it in a second time, and that generally suffices; cover it carefully from the dust for a week, then rub it gently with soft cotton wool, and you will have a brilliant shining gloss, resembling polished marble.

8.—*Mending Plaster Models.*—Sandarac varnish is the best material for mending plaster models. Saturate the broken surfaces thoroughly, press them well together and allow them to dry.

9.—*Polishing.*—The polish on plaster figures is said to be produced by immersion in melted paraffine or wax and rubbing smooth. A prize for such a process was offered by some society in Berlin.

10.—*Retarding the Setting of Plaster of Paris.*—When, for some reason, in making plaster casts or bandages, it becomes desirable to retard the setting of the plaster magma, this may be accomplished by adding to the water powdered althaea root in the proportion of 2 to 4%. When dry, such casts may be sawed, filed and turned. An addition of 8% of althaea retards setting for a full hour, and the mass may be kneaded, rolled and otherwise shaped. The addition of a very little alum or ferric chloride produces a very hard cast. Good plaster should not set in less than 3 minutes.

11.—*Silvering Plaster Models.*—Ordinary plaster models are covered with a thin coat of mica powder, which perfectly replaces the ordinary metallic substances. The mica plates are first cleaned and bleached by fire, boiled in hydrochloric acid and washed and dried. The material is then finely powdered, sifted and mingled with collodion, which serves as a vehicle for applying the compound with a paint brush. The objects thus prepared can be washed in water and are not liable to be injured by sulphureted acids or dust. The collodion adheres perfectly to glass, porcelain, wood, metals or papier mache.

12.—*Stuccoed Flowers from Plaster of Paris.*—Take natural flowers and coat the lower side of their petals and stamens with paraffine or with a mixture of glue, gypsum and lime, which is applied lightly. Very fine parts of the flower, such as stamens, etc., may be previously supported by special attachments of textures, wire, etc. After the drying of the coating the whole is covered with shellac solution or with a mixture of glue, gypsum, lime with lead acetate, oil, mucilage, glycerine, colophony, etc. If desired, the surface may now be painted with bronzes in various shades. Such flowers are now much employed in the form of festoons for decorating walls, ceilings, lusters, etc., and are very handsome.

13.—*Transparent Casts.* — Beautiful semi-transparent casts of fancy articles may be taken in a compound of 2 parts unbaked gypsum, 1 of bleached beeswax and 1 of paraffine. This becomes plastic at 120° F. and is quite tough.

14.—*Washable Casts.* — a. — Jacobsen prepares casts which retain no dust and can be washed with lukewarm soap water by immersing them or throwing upon them in a fine spray a hot solution of a soap prepared from stearic acid and soda lye in 10 times its quantity by weight of hot water.

b.—Shellhass recommends the coating of plaster-of-paris casts with a compound of finely powdered mica and collodian prepared as follows: The mica rendered perfectly white by boiling with hydrochloric acid or calcining, is ground very fine, sifted and elutriated and then mixed with dilute collodion to the consistency of oil paint and applied with a soft brush. Casts coated in this way possess a silvery luster, have the advantage of being indifferent to sulphurous exhalations and can be washed without injury.

c.—Coating or saturating the cast with a neutral soap from stearic acid and soda lye dissolved in 10 times the quantity of hot water is recommended. Cleaning of dust may be done with lukewarm water. Of special merit, however, is the following process: Leave the plaster-of-paris casts after complete drying for 24 hours in a cold barytes solution, wash them off carefully with cold water after removal, so as to eliminate the adhering barytes and allow them to dry 3 or 4 days at an ordinary room temperature. Next put them for a short time (about ½ hour) in a hot solution of 1 part grain soap in 15 to 20 parts water and dry them finally, after the adhering soap particles have been removed with water in suitable drying rooms.

d.—Thoroughly dry the plaster figure, cover with the best linseed oil, just warm. Take out in 12 hours and dry in a place free from dust. The figure looks like wax when dry and can be washed without injury.

Plaster of Paris.

This very useful material is made by calcining calcium sulphate (gypsum) at a temperature of 500° F., which all the water of crystallization is expelled. It is of the greatest use, especially in the formation of casts or molds.

1.—*Hardening.*—a.—Plaster of paris may be caused to set more quickly if some alum be dissolved in the water used for rendering it plastic. If the gypsum is first moistened with a solution of alum and then again burned, the resulting compound sets very quickly and becomes as hard as marble. Borax may be similarly employed. In 1877 the Prussian Government awarded 3 prizes for inventions submitted at its invitation of processes for hardening plaster-of-paris casts. The principle of all these consists in this, that the objects are to be treated with a solution of caustic baryta. But it has been found that no matter how deep this penetrates, the baryta is again drawn toward the surface when the water evaporates, a portion efflorescing on the outside and only a thin layer remaining in the outer shell, where it is converted into carbonate. This at the same time stops up the pores, rendering it impossible to repeat the operation. It was later found that the whole mass of the cast might be hardened by applying to it with a brush made of glass bristles a hot solution of baryta. To prevent separation of the crystallized baryta at the surface, the object must be raised to a temperature of 60 to 80° C. To produce good results, however, it is necessary to add to the plaster before casting certain substances with which the baryta can combine. These are silicic acid in some form, or the sulphates of zinc, magnesium, copper, iron, aluminum, etc. With some of these the resulting object may be colored. As it is, however, difficult to insure the production of uniform tint, it is better when employing salts producing color to mix the plaster with about 5% of quicklime, or, better, to render it plastic with milk of lime and then to soak the object in a solution of metallic sulphate.

b.—Mix the plaster of paris with a weak solution of gum arabic (½ oz. to ½ pt. of water) or for common uses with a weak solution of size. This not only makes the plaster hard, but gives smoothness to the surface.

c.—To a thin milk of lime, or lime water, add 14 or 15 drops of liquid silicate of soda for every pint of fluid used; this is then thickened with plaster to a thick cream. Plaster thus prepared will set in 5 minutes or thereabout, according to the thickness of the cream. If too much silicate is used, the soda will effervesce on the surface and spoil the sharpness of the impression.

d.—Ordinary plaster of paris is brittle, porous and hygroscopic, and by absorption of water becomes a conductor of the electric current, hence is unsuitable for electro-technical purposes. In a hardened condition, however, it is serviceable for parts which are neither under high tension nor exposed to high temperatures and great changes of temperature. In the latter case the expensive putty of litharge and glycerine must be used.

The hardening of the plaster of paris is accomplished in the following manner: Intimately mix with the powdered gypsum 2 to 4% of powdered marshmallow root and knead into a dough with 40% of water. The mass resembles fat clay, hardens after about 1 hour and is then so tough that it may be cut, filed, turned and drilled. An admixture of 8% of marshmallow root renders it still tougher. Instead of the marshmallow root, dextrin, gum arabic and glue may also be employed.

e.—If 6 parts of gypsum are mixed with 1 part freshly slaked lime and the articles in question shaped from this and saturated with concentrated magnesium sulphate solution the plaster becomes so hard that it cannot be scratched with the finger nail.

Lubricant for Plaster Molds.—The mixtures, greases and oils usually employed for this purpose have the disadvantage of being sticky or of easily attracting dust. According to Puscher, this drawback is avoided if stearic acid is used instead. Melt 1 part stearic acid in a glass by immersing the same in boiling water and add 4 to 5 parts alcohol (95%). Agitate the clear solution until cold, whereby a thin paste of very finely distributed stearic acid is formed, with which the molds are coated by means of a painting brush. The spirit evaporates at once and leaves a very thin layer of stearic acid, which admits of readily freeing the cast from the mold.

Pottery.

1.—*Glaze.*—The following glaze meets all requirements of practical pottery, as well as those of hygiene. Although somewhat slower in fluxing than the ordinary pottery glazes, it can very well be burnt in any potter's kiln, but it must be stated in advance that the vessels must be of equally good quality, as white as possible and fireproof. Thirty parts of litharge (30 parts protoxide of lead, 30 parts red lead), 5 parts white clay, 6 parts pure quartz sand. The glaze melts out well at about 2,190° F. To improve it very considerably it should remain fluid in the fire for some time—*i.e.*, when the drawn sample shows the smooth surface, firing should be continued evenly for another 2 hours. During this period the glaze combines more perfectly with the ware by melting the silicic acid in its exterior surface, this layer being vitrified thereby. A part of the lead oxide will be volatilized and this will make the glaze richer in silicic acid, consequently harder, denser and capable of withstanding the diluted acids such as are contained in articles of food and drink.

2.—*Gilding.*—a.—Dissolve in a tared

capsule any convenient quantity of pure gold in nitrohydrochloric acid and add to the solution sufficient uranium oxide to impart a rich brown color. Evaporate the liquid to dryness on a sand bath, cool the capsule and weigh. Then to the residue so ascertained and counted as 1 part add sulphur, 1 part; dammar rosin, 2 parts; turpentine oil, 6 parts. With due precautions against the mixture igniting, heat it over a quick fire, with constant agitation, until it becomes homogeneous and acquires a fine reddish brown color. Add while still hot sufficient rosemary oil to give it the consistency of a thick syrup. Finally, for every 100 parts of the gold originally used, add 35 parts of bismuth flux (bismuth trioxide, or bismuthous oxide, obtained by gently igniting basic bismuth nitrate) and let cool.

b.—China, Gilding on.—The gilding is done either by an adhesive varnish or by heat. The varnish is prepared by dissolving in hot boiled linseed oil an equal weight of either amber or copal. This is diluted with a proper quantity of oil of turpentine so as to be applied as thin as possible to the parts to be gilt. Let stand after varnishing about 24 hours, then heat in an oven until so warm as almost to burn the fingers when handled. The heat softens the varnish, which is then ready to receive the gold leaf, which may be applied with a brush or pledget of cotton, and the superfluous portions brushed off. Burnish when cold, interposing a piece of thin paper between the gold and burnisher. Where burning in is practiced the gold reduced to powder is mixed with powdered borax glass (anhydrous borax) moistened with a little gum water, and applied to the clean surface with a camel's-hair pencil. When quite dry the article is put into a stove heated to about the temperature of an annealing oven. The gum burns off and the borax, by vitrifying, cements the gold with great firmness to the surface.

c.—To Dissolve Gold for Gilding Which Has to Be Fired.—Triturate in a mortar some gold leaf and honey until reduced very fine. Then dissolve the honey with hot water and mix with a little gum water for use, or dissolve gold in hot aqua regia, evaporate to dryness in a porcelain dish and dissolve in ether for use.

Printed Matter, Preserving.

Printed matter will not fade, because printer's ink, being colored with carbon, is practically indestructible under ordinary conditions. The discoloration of the

paper, as a rule, is due to the effect of the residual bleaching material left in the paper pulp when it was made—that is, chloride of lime; in good paper, however, "antichlores" are now used to destroy the excess of chloride. Newspapers, being made of common stuff, are sure to become brown and rotten in time. Dampness also causes the growth of microscopic molds, which destroy the fibers. The discoloration may be prevented to some extent by keeping the paper in a thoroughly dry place. If expense is not objected to, a thin varnish of collodion will help to keep the paper a good color.

Prints.

Bleaching.—To bleach old prints prepare 3 solutions as follows: (a) Mix 2 oz. of chloride of lime with 1 pt. of water; dissolve 3 oz. of washing soda in 1 pt. of water and mix. Allow the precipitate to subside and use only the clear liquid. (b) Dissolve 1 oz. of sulphite of soda in 1 pt. of water. (c) Add 1 pt. of water to 2 oz. of strong pure hydrochloric acid. A shallow dish large enough to take a print will be required. Place water in the dish and float the print in it till thoroughly wetted. Now remove the print, add 1 oz. of solution (a) and replace the print; allow it to remain for a few hours; if thoroughly bleached run off the liquid, wash the print in running water, then add a few drops of (b) solution; allow to stand for about an hour again wash in running water for about an hour, remove the print to clean white blotting paper, drain and dry. If the print is not properly bleached by (a) solution, pour off the latter, add water to the dish and a few drops of (c) solution, allow to stand, wash, treat with (b) solution and finish as above described.

Coloring.—Place the print face upward on clean cardboard; put weights on the corners to keep it down and pass a piece of stale bread gently over to remove any surface dirt. Now prepare the requisite tints in water-color and lay on bread washes with a large-sized camel's-hair pencil. Large tools must be used where much ground has to be covered with any color, as the absorbent nature of the printing papers in general use renders it impossible to get an even tint otherwise indeed, it will often be found necessary to allow large surfaces, such as sky, etc., to absorb a considerable quantity of water (applied evenly with a camel's-hair tool) before the laying-in of color is attempted. Body color—that to which white has been added—is used sparingly, and only, as a rule, to heighten the effect of jewelry, armor, etc. When the coloring is finished pass carefully over the deep shadows with a weak solution of gum arabic. This gives force to the work and depth and transparency to the dark parts. The gum must not be used strong or it will crack immediately the print is rolled.

Mounting Engravings Printed on Silk.—The safest plan is lay the silk face downward on a drawing-board and then drive in a row of tacks all round the silk, about 2 in. or 3 in. from its edge. Next, opposite each tack, take a stitch with needle and thread through the silk (going just far enough into the material to get a firm hold) and secure the thread by winding it round the tack. When this has been done all round the threads must be very gradually tightened, special care being taken that the fabric is not pulled awry. By this means, if due patience and care are exercised, perfect smoothness may be secured, because the threads are only lightly fastened by a few turns round the tacks and can be unwound and tightened anywhere as required. A piece of millboard that has been glued round the edges only is then laid on the silk and pressed until the glue has set. The silk can then be turned face upward and mounted.

Pasting Prints in Scrap-book.—Touch the corners only of the print with a mixture of glue and paste; then, if the picture is dropped into position and pressed down, it will lie smooth. When it is necessary to paste a print all over, the paste should be allowed to set partly before mounting and a very thin coat only applied; then, while the prints are wet, close the book and place heavy pressure upon it. However, no precaution will entirely prevent wrinkles on a paper so thin as cartridge.

Reproducing Old Prints.—The following is the process employed in a Paris concern that makes a specialty of lithographic facsimiles of old and rare prints (which facsimiles are sold as genuine antiques): Prepare a bath as follows: Sulphuric acid, 3 to 5 parts (according to the antiquity of print, thickness of paper, etc.); alcohol, 3 to 5 parts; water, 100 parts. In this soak the print from 5 to 15 minutes (the time depending on age, etc., as above), remove, spread face downward on a glass or ebonite plate, and wash thoroughly in a gentle stream of running water. If the paper is heavy, reverse the sides and let the water flow over the face of the print as well. Remove carefully and place on a heavy sheet of blotting paper, cover with another and press out every drop of water possible. Where a wringing machine is convenient and sufficiently wide, passing the blotters and print through the rollers is better than mere pressing with the hands. The print, still moist, is then laid face upward on a heavy glass plate (a marble slab or a lithographer's stone answers equally well) and smoothed out. With a very soft sponge go over the surface with a thin coating of gum arabic water. The print is now ready for inking, which is done exactly as in lithographing, with a roller and printer's or lithographer's ink, cut with oil of turpentine. Suitable paper is then laid on and rolled with a dry roller. This gives a reverse image of the print, which is then applied to a zinc plate or a lithographer's stone, and as many prints as desired pulled off in the usual lithographing method. When carefully done and the right kind of paper used, it is said that the imitation of the original is very perfect in every detail.

Size (Ackerman's Liquor).—Use 4 oz. each of the finest pale glue and white curd soap; boiling water, 3 pt., 12 fl.oz.; dissolve, then add of powdered alum 2 oz. Used to size prints and pictures before coloring them.

Ribbons, Silvering of.

Make a solution of nitrate of silver and add a little gum to it, so that the liquid will not run. Then with a camel's-hair pencil or a new pen draw any sort of ornamental figure on the silk. After the drawing is dry, hold the ribbon over a vessel containing water, zinc and a little sulphuric acid. In a short time the silver will be reduced and adhere quite strongly to the fabric. Arabesques, wreaths, etc., executed in this manner have a pretty appearance.

Shells, Silvering.

Grind silver leaf in gum water to the required thickness and apply to the inside of the shell. For gold color grind gold leaf in gum water.

Signs.

Gilding Letters.—1.—When the sign is prepared as smooth as possible, go over it with a sizing made by white of an egg, dissolved in about 4 times its weight of cold water, adding a small quantity of fuller's earth; this to prevent the gold sticking to any part but letters. When dry set out the letters and commence writing, laying on the size as thinly as possible with a sble pencil. Let it stand until you can hardly feel a slight stickiness; then go to work with your gold leaf knife and cushion and gild the letters. Take a leaf upon the point of your knife, after giving it a slight puff into the back part of your cushion, and spread it on the front part of it as straight as possible; give it another slight puff with your mouth to flatten it out. Now cut it to the proper size, cutting with the heel of your knife forward. Now rub the tip of the knife lightly on your hair; take up the gold on the point and place it neatly on the letters. When they are all covered, get some very fine cotton wool and gently rub the foil until it is smooth and bright. Then wash the sign with clean water to take off the egg size.

2.—Use gold and silver leaf. Take a little fine isinglass, as much as will lie on a 5-cent piece, and dissolve in a little boiling water. Add as much alcohol as there is water and strain through silk. Paint the letters on a sheet of paper with Brunswick black; fix the paper, with the writing reversed, on the glass. Use the isinglass solution as a mordant, laying it on with a camel's-hair pencil, and then apply the gold leaf. Place the glass in a warm room and when the gilding is dry rub over with a piece of cotton wool. Pass a flat camel's-hair brush, moistened with the isinglass solution, lightly over the gold letters; let the solution be hot for this operation. A second coating of gold leaf will improve the work. Mark in the outline on the back with soap, use a size composed of gum tragacanth in water, have the size as thin as possible.

Silvering.

Silver Leaf, Varnished.—Use, first, prepared oxgall; next, isinglass; then alum to kill the former; finish with hard white lac.

Silver Size, Preparation of.—Put in a pan Spanish chalk, 4½ oz.; Venetian soap, ½ oz.; beeswax, ½ oz., and finely pulverized fat pipeclay, 9 oz.; roast thoroughly. Rub fine with the whites of 40 eggs. Form the mass into small balls, dry upon a glass plate. To apply the size, triturate a piece with water, then put in a glass and dilute with water. Brush the frame with the dissolved size and let it dry before applying another cast. (See also chapter on PAINTS, etc.)

Tracing.

1.—*Drawings.*—a.—If the paper upon which the tracing is to be made is soaked with benzine by means of a cotton pad, sopping it into the pores of the paper, the latter will become so transparent that the most delicate lines and tints may be seen more readily than through the finest tracing paper. Indian ink, water colors or pencil take equally well upon paper thus treated and last better than upon any other kind of tracing paper. Any kind of opaque drawing paper in ordinary use may be employed for this purpose, stretched in the usual manner over the drawing to be traced. The benzine rapidly evaporates and the paper resumes its original opaque appearance without showing the slightest trace of the process to which it has been subjected. When large pictures are to be traced, the benzine should only be applied to a part of the paper at a time, in accordance with the progress of the work.

2.—*Cleaning.*—Tracing cloth may be very quickly and easily cleaned and pencil marks removed by the use of benzine, which is applied to a cotton swab. It may be rubbed freely over the tracing without injury to lines drawn in ink or even in water color, but the pencil marks and dirt will quickly disappear. The benzine evaporates almost immediately, leaving the tracing unharmed. It must, however, be borne in mind that the surface has been softened and must be rubbed down with talc or some similar substance before drawing any more ink lines.

The glaze may be restored to tracing cloth after using the eraser by rubbing over the roughened surface with a piece of hard wax from an old phonograph cylinder. The surface thus produced is superior to that of the original glaze, as it is absolutely oil and water proof.

In the Rushmore works all pencil drawings that go into the shop are first rubbed over with this wax, and it has been found that while common pencil drawings are soon destroyed by dirt and grease, those treated with the wax return to the drawing room after the completion of special jobs without the slightest blemish.

Cloth.—1.—Boiled linseed oil, bleached, 10 lb.; lead shavings, ½ lb.; zinc oxide, 2½ lb.; Venetian turpentine, ¼ lb. Boil for several hours, then strain and dissolve in the strained composition 2½ lb. white gum copal. Remove from the fire, and when partly cold add oil of turpentine (purified), sufficient to bring it to proper consistency. Moisten the cloth thoroughly in benzole and give it a flowing coat of the varnish.

2.—Varnish the cloth with Canada balsam dissolved in turpentine, to which may be added a few drops of castor oil, but do not add too much or it will not dry. Try a little piece first with a small quantity of varnish. The kind of cloth to use is fine linen; don't let the varnish be too thick.

Coloring.—It is always best to color tracings on the back, as the ink lines are liable to be obliterated when the color is applied. Mix the colors very dark, so that they may appear of proper depth on the other side. If ink or color does not run freely on tracing cloth, mix both with a little oxgall.

Tracing Paper.—The following receipts are from the "Mechanics' Own Book":

1.—A German invention has for its object the rendering more or less transparent of paper used for writing or drawing, either with ink, pencil or crayon, and also to give the paper such a surface that such writing or drawing may be completely removed by washing, without in any way injuring the paper. The object of making the paper translucent is that when used in schools the scholars can trace the copy and thus become proficient in the formation of letters without the explanations usually necessary; and it may also be used in any place where tracings may be required, as by laying the paper over the object to be copied it can be plainly seen. Writing paper is used by preference, its preparation consisting in first saturating it with benzine and then immediately coating the paper with a suitable rapidly drying varnish before the benzine can evaporate. The application of varnish is by preference made by plunging the paper into a bath of it, but it may be applied with a brush or sponge. The varnish is prepared of the following ingredients: Boiled bleached linseed oil, 20 lb.; lead shavings, 1 lb.; zinc oxide, 5 lb.; Venetian turpentine, ½ lb. Mix and boil 8 hours. After cooling, strain and add 5 lb. white copal and ½ lb. sandarac.

2.—The following is a capital method of preparing tracing paper for architectural or engineering tracings: Take common tissue or cap paper, any size of sheet; lay each sheet on a flat surface and sponge over (one side) with the following, taking care not to miss any part of the surface: Canada balsam, 2 pt.; spirits of turpentine, 3 pt.; to which add a few drops of old nut oil; a sponge is the best instrument for applying the mixture, which should be used warm. As each sheet is prepared it should be hung up to dry over 2 cords stretched tightly and parallel, about 8 in. apart, to prevent the lower edges of the paper from coming in contact. As soon as dry the sheets should be carefully rolled on straight and smooth wooden rollers about 2 in. in diameter, covered with paper. The sheets will be dry when no stickiness can be felt. A little practice will enable any one to make good tracing paper in this way at a moderate rate. The composition gives substance to the tissue paper.

3.—You may make paper sufficiently transparent for tracing by saturating it with spirits of turpentine or benzoline. As long as the paper continues to be moistened with either of these you can carry on your tracing; when the spirit has evaporated the paper will be opaque. Ink or water colors may be used on the surface without running.

4.—A convenient method for rendering ordinary drawing paper transparent for the purpose of making tracings and of removing its transparency, so as to restore its former appearance when the drawing is completed, has been invented by Puscher. It consists in dissolving a given quantity of castor oil in 1, 2 or 3 volumes of absolute alcohol, according to the thickness of the paper, and applying it by means of a sponge. The alcohol evaporates in a few minutes and the tracing paper is dry and ready for immediate use. The drawing or tracing can be made either with lead pencil or Indian ink, and the oil removed from the paper by immersing it in absolute alcohol, thus restoring its original opacity. The alcohol employed in removing the oil is, of course, preserved for diluting the oil used in preparing the next sheet.

5.—Put ¼ oz. gum mastic into a bottle holding 6 oz. best spirits of turpentine, shaking it up day by day; when thoroughly dissolved it is ready for use. It can be made thinner at any time by adding more turps. Then take some sheets of the best quality tissue paper, open them and apply the mixture with a small brush. Hang up to dry.

6.—Saturate ordinary writing paper with petroleum and wipe the surface dry.

7.—Lay a sheet of fine white wove tissue paper on a clean board, brush it softly on both sides with a solution of beeswax in spirits of turpentine (say about ½ oz. in ½ pt.) and hang to dry for a few days out of the dust.

8.—Steep sheets of suitable paper in a strong solution of gum arabic and afterward take off the superfluity of the liquid by pressing each sheet between two others of similar paper, but dry. It will be found that the 3 sheets are converted into a first-rate tracing paper. It is indispensable that the solution be strong, about the consistency of boiled oil. Paper prepared as above directed possesses every requisite that can be wished for.

9.—Tracing Paper That May Be Washed.—Use writing paper, saturate it with benzine and then immediately coat the paper with a suitable, rapidly drying varnish before the benzine can evaporate. The varnish is prepared as follows: Boiled bleached linseed oil, 20 lb.; lead shavings, 1 lb.; zinc oxide, 5 lb.; Venice turpentine, ½ lb.; mix and boil for 8 hours. After cooling strain and add white gum copal, 5 lb., and gum sandarac, ½ lb. Thus prepared the paper will be found to possess all the requisites for use as stated above.

Transfer Paper.

1.—Rub the surface of thin post or tissue paper with graphite, black lead, vermilion, red chalk or other pigment and carefully remove the excess of coloring matter by rubbing with a clean rag.

2.—Rub into thin white paper a mixture of 6 parts lard and 1 part beeswax, with sufficient fine lampblack to give it a good color; apply the mixture warm and not in excess.

3.—Under exactly the same conditions use a compound consisting of tallow, 2 oz.; powdered black lead (graphite), ½ oz.; linseed oil, ¼ pt., and enough lampblack to produce a creamy consistency.

4.—Black Transfer Paper.—Get some unglazed paper and rub it well with a paste made of gas black or black from a paraffine lamp and olive oil, with a piece of sponge.

5.—Writing and Drawing on Transfer Paper.—To dissolve solid lithograph ink, warm the pot at the fire or gas, using rain or distilled water to rub it down with, as it is softer than other water. The pen will be found to work better at first if it is dipped in oil and then wiped previous to writing.

6.—Brackelsberg's multiplying paper consists of sheets of paper, each one supplied with a coloring layer whose principal element is a violet aniline methyl. An oiled leaf serves as a hard, smooth under layer. Place a sheet of the copy paper on this, then a sheet of writing paper and write with a hard lead pencil. The back of the writing paper will give a negative of the writing in high color. Wet the copy sheet thoroughly, and from it 20 or more copies can be made, which will not roll nor show a gelatinous coating. Embroidery and compass sawing patterns are finely rendered in this way.

Coloring Transfer Paper.—The addition of coloring matter to transfer paper is for the more ready determination of the coated side. Gamboge is generally used, but any kind of coloring matter will answer the purpose. A light pink tint is distinguishable by artificial light, while a yellow is scarcely visible. Rose pink or a solution of cochineal in ammonia answers this purpose.

Decalque Rapide.—The new transfer paper invented by J. B. Duramy consists of a paper of the kind generally used for making pottery transfers, but coated with a mixture of gum and arrowroot solutions, in the proportion of 2½ parts of the latter to 100 of the former. The coating is applied in the ordinary manner, but the paper is only semi-glazed. Furthermore, to decorate pottery ware by means of this new transfer paper there is no need to immerse the ware in a bath in order to get the paper to draw off, as it will come away when moistened with a damp sponge, after having been in position for less than 5 minutes, whereas the ordinary papers require a much longer time.

Lithographic Transfer Paper.—Dissolve in water ½ oz. gum tragacanth. Strain and add 1 oz. of glue and 1 oz. of gamboge. Then take French chalk, 4 oz.; old plaster of paris, ½ oz.; starch, 1 oz.; powder and sift through a fine sieve; grind up with the gum, glue and gamboge; then add sufficient water to give it the consistency of oil and apply with a brush to thin sized paper.

Stones, Paper for Cold.—Take 4 oz. of starch and 1 oz. best pale-colored glue. Break the glue and put it in cold water overnight to soak. Mix the starch with a little cold water and then pour boiling water upon it till it thickens, stirring it all the time. Now put in the glue and boil over a slow fire or gas jet; brush over the paper while warm. This may be used on tracing paper, printing paper or writing paper. For ordinary use printing paper is preferable, because the water penetrates more quickly through the back of it in transferring. Some persons add a little flake white. If a more adhesive paper is required, a common kind of glue may be used and its proportion increased, or gum arabic, or even dextrine, may be added.

Stones, Paper for Warm.—Make a size by boiling parchment cuttings. Let it be so strong that when cold it will be firm jelly. Grind dry flake white with water, add it to the size after warming it, mix well and rub through a sieve. The proportion of flake white may vary with circumstances. If too much be used pens will not work upon it properly, and probably the finest lines will fail in transferring. Coat the paper with the composition with a full brush or use a sponge and give 2 coats, the second when the first is dry. If for writing, the paper may be thin, if for drawing it should be thicker, using drawing paper for very large subjects. The stone for this paper should be quite warm. Similar paper is made from gelatine or from the better sorts of glue, instead of parchment cuttings. Other substances are also used instead of flake white, such as chalk and old plaster of paris. Flake white is best because it grinds up so finely.

Transferring.

1.—*Engravings.*—a.—The liquid used for this purpose may be made by dissolving 1½ dr. of common yellow soap in 1 pt. of hot water, adding when nearly cool ¾ fl.oz. of spirit of turpentine and shaking thoroughly together. Apply the fluid liberally to the surface of the engraving or other printed matter with a soft brush or sponge (being careful not to smear the ink, which soon becomes softened), and allow it to soak for a few minutes. Then well damp the plain paper, on which the transfer is to be made, place it upon the engraving and subject the whole to moderate pressure for about 1 minute. On separating them a reversed transfer will be found on the paper. The transfer will not be equal in intensity to the original, as only a part of the printer's ink is removed. If the ink be very old, a longer soaking and more pressure may be necessary.

b.—Engravings may be transferred on white paper as follows: Place the engraving a few seconds over the vapor of iodine. Dip a slip of white paper in a weak solution of starch, and when dry in a weak solution of oil of vitriol. When again dry lay a slip upon the engraving and place both for a few minutes under a press. The engraving will be reproduced in all its delicacy and finish.

2.—*Pictures, Prints, etc.*—a.—In order to transfer prints of various kinds to glass, wood, etc., soak them for a short time in a solution of 10 parts of potassium hydrate in 90 parts of alcohol (more or less). This procedure is to soften the varnish in the printer's ink. After rinsing in pure water the print is placed face down on the plate which is to receive the picture or print, covered with a dry sheet and then pressed with squeegee or in a letter press.

Colored prints are painted over with a colorless, sticky varnish, pressed against the object intended to receive them, and, when dry, the paper is removed by rubbing cautiously with an aqueous solution of potash.

b.—Some years ago a French typographical journal gave the following curious process for the reproduction of any printed design whatever—pictures, printed pages, etc. The paper to receive the reproduction is treated with the following, which is applied with a sponge, or, preferably, with a soft, flat brush: Gelatine, 10 parts; ferric chloride, 22 parts; tartaric acid, 10 parts; zinc sulphate, 10 parts; distilled water, 400 parts. Mix in the dark and keep in a deep, orange-colored glass bottle (an ordinary bottle, tightly covered with a heavy, yellow-colored paper, and kept in a close pasteboard box, will answer). The coating should be applied in a dark place and the paper dried in the dark. When dry, place the design on the coated surface and bring into close contact. Place on a sheet of glass, cover with another, clamp together and expose to the direct rays of the sun until the yellow cover of the surface of the sensitive paper is bleached to a white. Remove from light and develop by leaving for 3 or 4 minutes in the following: Gallic acid, 2 parts; alcohol, 7 parts; distilled water, 100 parts. If left exposed exactly the right length of time the lines will appear on a white ground of an intensely black color. If exposed too long they will become more or less gray.

c.—To Glass.—a.—First coat the glass with dammar varnish or else with Canada balsam mixed with an equal volume of oil of turpentine and let it dry until it is very sticky, which takes half a day or more. The picture or printed paper to be transferred should be well soaked in soft water and carefully laid upon the printed glass, after removing surplus water with blotting paper and pressing upon it, so that no air bubbles or drops of water are seen underneath. The picture should then dry a whole day before it is touched; then with wetted fingers begin to rub off the paper at the back. If this be skilfully done, almost the whole of the paper can be removed, leaving simply the ink upon the varnish. When the paper has been removed another coat of a varnish will serve to make the whole more transparent.

d.—Any picture, print or even clipping from newspapers, any engraving, no matter in how many colors, or on what kind of paper, may be transferred to glass, says an art journal, only the treatment of the different kinds of paper differs. Proceed in the following manner: Place the object to be transferred, face downward, upon a larger sheet of manila paper; prepare a solution of from 1 to 3% of nitric acid in water, according to thickness and strength of paper and how strong it was sized; ordinary newspapers and printings or engravings on unsized glaze paper require even less than 1% nitric acid—one of the purposes of adding nitric acid is to remove the sizing out of the paper. This solution apply with a sponge to the back of your object to be transferred; be careful not to overdo it; you only want to render the paper soft, but not wet. Continue sponging with this solution until you see the printing plainly; that is, until the paper becomes quite transparent.

To prepare the glass for transferring proceed as follows: Clean the glass plate thoroughly with alcohol by means of a ball of clean cotton. Dry it off well; wash it with turpentine; dry it off again; place the glass plate upon a smooth elastic layer—for instance, flannel—and with this elastic layer upon a table, or better yet, upon a rubber blanket in the litho hand-press. Now coat the cleaned surface with a thin coat of half turpentine and half dammar varnish; let it dry from 10 minutes to 1 day according to temperature and thickness of dammar varnish. The coating should not be allowed to dry entirely; it should be a trifle adhesive. Lay your impression face downward upon the glass plate; it is important that neither acid nor water touches the surface during the entire process. To properly lay down the impression, take it up with both hands by holding the left-hand under corner and the right-hand upper corner; be careful not to get any air bubbles under the sheet. This is best accomplished by marking upon the plate the exact position and size of the sheet.

Laying down the paper first, adjust the right-hand upper corner to the mark on the plate, hold it there with the tip of your finger and adjust the left-hand lower corner, but be careful to avoid air bubbles.

Press the sheet to the adhesive dammar coat. This may be done in many different manners. It does not require a very strong pressure, but it should be observed that each and every spot has to be pressed repeatedly against the plate. When the paper sticks quite smoothly to the plate, fan it perfectly dry, and then, with wet finger tips, slowly rub off the paper.

If this is done with great care you will remove every vestige of paper, and the print, of whatever color or nature it may be, will remain on the glass plate. Upon this apply another coat of dammar varnish containing very little turpentine. With too much turpentine you run the risk of washing the entire picture from the plate again.

e.—To Glass, Steel, etc.—To transfer prints to polished steel or to glass make a varnish as follows: Gum sandarac, 4 oz.; mastic, 1 oz.; Venice turpentine, 1 oz.; alcohol, 15 oz., or any smaller quantity in proportion. Digest in a bottle, with frequent shaking. Moisten the print slightly upon the back by laying a wet cloth upon it; then varnish the steel plate or glass with a thin, even coat; lay the print with the face next to the varnish, commencing on one side so as not to inclose air bubbles, pressing it down close with the fingers if the print is small, or a soft roller if the print is large. Be careful that all parts of the print are in contact with the varnish. Lay aside to dry. After it is dry, wet the back with water and cautiously rub the paper off with the fingers; rub lightly toward the last with plenty of water, and the surface of the varnish will come up smooth with the ink of the print solidly imbedded. Then a thin coat of mastic varnish will give it a finish.

4.—*Newspaper Pictures.*—Prepare a liquid by dissolving 1½ dr. common yellow soap in 1 pt. of hot water, adding, when nearly cold, 3¼ fl.oz. spirits of turpentine and shaking thoroughly together. This fluid is applied liberally to the surface of the printed matter with a soft brush or sponge (being careful not to smear the ink, which soon becomes softened) and allowed to soak for a few minutes; then well damp the plain paper on which the transfer is to be made, place it upon the engraving and subject the whole to moderate pressure for about 1 minute. On separating them a reversed transfer will be found on the paper.

5.—*Ornamenting.*—There are many different ways of putting on the ornament, some preferring one way, others a different method, according to circumstances and individual skill. We shall endeavor to give the most simple and successful method known.

First, let it be understood that all pictures that show the colors complete are only suitable for white or very light-colored brown; those that are covered with a white grounding, gold, metal or silver leaf can be used on any color, light or dark. After getting the work ready for ornamenting, give the picture a smooth, thin coat of some quick-drying copal varnish, thinned with turpentine (other preparations are used of which we will speak hereafter), being careful not to go beyond the outline of the design. Allow it to dry until it has a good tack and put it on the work in its proper place. Roll it smooth with an Indian rubber roller or smooth it with a paper folder until every part adheres well. (For very large pieces it is well to lay them, after they have the right tack, between 2 sheets of damp blotting paper. It will stretch the paper and make a smooth transfer.) Now wet the paper, smoothing it down at the same time, until it has absorbed all the water possible; leave it about a minute and pull off the paper carefully. Should any parts of the design still adhere to the paper, press it down again, wet-rub it until it separates easily.

After having removed the paper, press the design on well and wash and dry it off. Should any blisters appear, prick them with a pin and press down. In a few hours the design may be varnished, which will increase the brilliancy of the colors.

6.—*To Paper.*—a.—A very weak solution of soft soap and pearlashes is used to transfer recent prints, such as illustrations from papers, etc., to unglazed paper. Soft soap, ½ oz.; pearlash, 2 dr.; distilled water, 16 fl.oz. The print is laid upon a flat surface, such as a drawing board, and moistened with the liquid. The paper on which the reproduction is required is laid over this, and then a sheet of thicker paper placed on the top, and the whole rubbed evenly and hard with a blunt instrument, such as the bowl of a spoon, until the desired depth of color in the transfer is obtained. Another and more artistic process is to cover the print with a transparent sheet of material coated with wax, to trace out the pictures with a point and to take rubbings of the same after powdering with plumbago.

b.—Printing ink may be loosened and rendered transferable by several substances, but probably the best are creosote, or oil of tar, and balsam of copaiba. To obtain a reversed picture, brush a plentiful quantity of creosote (10c. per oz.) quickly over the original print. It acts immediately, so be careful not to smear the ink by unnecessary brushing. Dissolve 1 oz. of common soda or 1 oz. of oxalic acid in 1 pt. of water and moisten the paper on which the reversed impression is to appear When the creosote has soaked well into the print, transfer by placing it face downward on the damp paper and rubbing the back with any smooth, hard article, and a clear picture will be the result. Transparencies are made by coating the paper with a mixture of 1 part Canada balsam and 2 parts spirit of turpentine instead of the soda or acid solutions, and letting it dry thoroughly before transferring the picture.

7.—*Wagons, Transferring Pictures to.*—Cover the picture entirely (taking care not to go beyond the outlines) with a slight coat of fixing varnish, then put the picture on the object to be ornamented, being careful to place it properly at once, to avoid spoiling it by moving. The varnish newly applied being too liquid, the picture should be allowed to dry for about 10 minutes and placed on the object to be ornamented when just damp enough to be adherent; this done, cover the back of the picture with a piece of cloth steeped in water; then, by means of a knife or penholder, rub it all over, so as to fix every part of it; then remove the piece of cloth and rinse the paper with a paint brush steeped in water; at the end of a few minutes the paper will come off, leaving the painting transferred. Care must be taken that the piece of cloth, without being too wet, is sufficiently so for the paper to be entirely saturated. The picture must now be washed with a wet brush and dried very lightly with some blotting paper. Keep the ornamented article in a warm, dry place until dry. The polishing varnish should not be applied until the next day, keeping the pictures meanwhile out of the dust. The latter varnish should be applied as lightly as possible. If dark-colored objects are to be ornamented, the picture should first be covered with a mixture of white lead and turpentine, following the outlines of the design and covering it entirely. When this coat is perfectly dry proceed as above.

8.—*Wood Transferring Pictures to.*—a.—Wood surfaces (white woods, lime, maple, poplar, etc.) should first be rubbed smooth with decolorized linseed oil, then dried over a coal fire and given 3 coats, one after another, of a varnish made of 30 parts of sandarac, 15 parts shellac, 15 parts turpentine and 375 parts of alcohol (90%). The varnish may be colored at discretion with dragon's blood, turmeric, etc. The engraving to be transferred is thoroughly soaked in salt water and spread on blotting paper, remaining moist. A smooth board, as hot as possible, and screw clamps must be all ready. The wood surface must be again coated with varnish, also the picture on the printed side. It must then be laid smoothly on the wood surface, over it a piece of flannel and on that the heated board, and the whole pressed tightly together by means of the screw clamps. After a few hours it will be dry. Rub the back of the picture with linen rags, wet with water, until the greater part of the paper is rubbed off; cover the surface with linseed oil and rub off any parts of the paper that remain with the finger. The picture surface can then be rubbed down with linseed oil and linen rags, dried, the surface varnishing repeated 10 times and finally given a coat of copal varnish and polished.

b.—First varnish the wood once with white hard varnish, then cut off the margins of the print, which should be on unsized paper. Wet the back of it with a sponge and water, using enough water to saturate the paper, but not so as to be watery on the printed side. Then, with a flat camel's-hair brush, give it a coat of transfer (alcohol) varnish on the printed side and apply it immediately, varnished side downward, on the woodwork, placing a sheet of paper on it and pressing it down evenly with the hand till every part adheres. After standing a short time, gently rub away the back of the print with the fingers, till nothing but a thin pulp remains. It may require being wetted again before all that will come (or rather ought to come) off is removed. Great care is required in this operation, that the design or printed side be not disturbed. When this is done and quite dry, give the work a coat of white hard varnish and it will appear as if printed on the wood.

c.—Boxwood for Engraving.—A solution of potash or lye is used to soften prints, by means of which and heavy pressure they are transferred to boxwood and then re-engraved by hand. In order to make a printing block without re-engraving as above the photo process must be employed.

9.—*Writing, Transferring to Type Metal.*—Sprinkle the ink lines, while moist, with gum arabic in finest powder. When perfectly dry dust off excess, stretch the paper on a smooth level backing and pour on the fusible metal.

Vellum, Cleansing. (See CLEANSING.)

Vellum, Coloring.

For a green dye take 1 oz. of verdigris and 1 oz. of white wine vinegar and place in a bottle near the fire for a few days, shaking it 3 or 4 times a day. Previous to applying the dye wash the vellum with a weak solution of salt of tartar. Then, when dry, wash with the green solution to the shade required. For a red dye: To 1 pt. of white wine vinegar add ¼ lb. of Brazil dust and a small piece of alum. Cork the mixture up and let it stand in a warm place for a few days before applying. There are one or two points to be attended to before applying.

Wood, Gold Leaf on.

The surface must first be very carefully prepared, and when quite dry treated with the appropriate gold size, which is laid on with a very soft hog's-hair brush or camel's-hair pencil; several coatings are applied, each being dry before the application of the other, and finally smoothed down. To this surface the gold leaf, cut into suitable sized pieces, is taken up by the tip of a special brush and laid on to the prepared surface, pressed down by a dry camel's-hair brush, and so on piece after piece until the whole surface is covered. The whole operation, as we say, is one which requires much experience to carry out satisfactorily. Finally, when dry, certain parts of the gilded frame are burnished with a flint or agate burnisher specially made for the purpose. See also BURNT WOOD, PICTURE FRAMES above.

CHAPTER V

BEVERAGES

(For page numbers of individual formulas see Index)

BRIEF SCHEME OF CLASSIFICATION

NON-ALCOHOLIC BEVERAGES

- CARBONATED AND ARTIFICIAL MINERAL WATERS
- COLORING AGENTS
- ESSENCES AND EXTRACTS
- SYRUPS
- FOAM
- FRUIT JUICES
- NON-ALCOHOLIC BEERS
- EGG AND MILK DRINKS
- FRAPPES
- GINGER ALES, POP, ETC.
- GLACES
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- ICE CREAM BEVERAGES
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- MALT BEVERAGES

NON-ALCOHOLIC BEVERAGES, *Con.*

- MALTED MILK
- MEAD
- PHOSPHATES
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ALCOHOLIC BEVERAGES

- ESSENCES FOR ALCOHOLIC BEVERAGES
- LIQUORS (LIQUEURS) AND CORDIALS
- MIXED DRINKS
- WINES AND WINE MAKING

CARBORATED AND ARTIFICIAL MINERAL WATERS

Carbonating Water for the Fountain.

Properly carbonating the water used at the fountain is an important operation for the successful dispensing of soda water.

When the normal temperature is about 76 to 80° F., water at this same temperature will not absorb more than about 60 per cent. of gas; the balance of the gas refusing to blend with the water, it rises to the top of the carbonator dome and merely registers with a false pressure.

The gas that remains in the water will throw off or leave the water almost immediately upon being drawn, and this is because the gas globules are only immersed and not throughly blended with the water. To obtain the best results in the carbonator and to give the water a lasting effervescence, it is advisable to use cold water that has been chilled by refrigeration and not by putting ice in the water. The proper temperature of water for good carbonation is 42 to 45° F. At this temperature the gas absorption is from 92 to 98°. The water must not be colder than this or the carbonic-acid gas will form tiny ice globules in the carbonator.

Cold water and carbonic-acid gas have an affinity for each other and will remain in saturation, the gas thoroughly permeating the water, whereas in the case of warm weather or water it is merely immersed.

Artificial Mineral Waters.

Mineral waters, both natural and artificial, have been used from time out of mind. We have it on good authority that the old Romans made artificial mineral waters in imitation of the natural springs of Sicily, Gaul and Iberia, while, during the Middle Ages, the alchemists made an endless number of such imitations. In fact, the origin of soda water is due to these attempts at reproducing the natural mineral waters, and the generic name of "seltzer" water, which is the common term employed to-day among the Latin races to designate "plain soda", and is not uncommon even in England and America, owed its adoption to the fact that one of the most popular of these artificial mineral waters was the imitation of the natural water obtained from the springs of Selters, near Frankfort. The virtues of these waters were soon found to be due mainly to the carbonic-acid gas they contained, and the other ingredients were gradually dropped in the imitations. Bicarbonate of soda was the last ingredient to be retained, and consequently the name "soda water" has persisted to the present time.

The sale of mineral waters by druggists is much larger than would be commonly believed, and as the profit on this class of goods is much greater than that on the sweetened drinks, it pays to push their sale, and as they are more refreshing in the long run than a syruped drink, it should not be a difficult matter largely to increase the custom for these goods.

Artificial and Natural Waters Contrasted.—An authority, Mr. Thomas Warwick, says: True, I have heard it urged that any mineral water if drunk in excess is likely to produce bad effects on the system, and this is undoubtedly the case with certain of the mineral waters, but I doubt very much if either plain soda or Vichy could ever be really harmful in the doses in which they are served up at the soda fountain. Even at the Saratoga Springs, where a customer is allowed for five cents all the mineral water he wishes to drink, I was unable to learn of any case of evil effects arising from the practice, and although I have personally known several soda water "topers," I never knew of one who suffered from his overindulgence, while I did know a number who experienced very beneficial results from the use of this beverage. The above remarks apply as well to the artificial waters as to the natural ones, for in spite of the assertions of the mineral spring owners to the contrary, the natural and the artificial waters are practically the same in their effects on the system. If anything, the artificial waters are more uniform in quality and less likely to contain traces of injurious matters. Where the mineral spring obtains its great advantage is in the change of scene a trip thither necessitates and in the regime which has to be followed. When the choice is between a natural mineral water in bottles and a careful imitation of the same, the imitation is generally better than the natural water.

How Artificial Waters Must Be Made.—In making an artificial mineral water it must be remembered that it is seldom possible to reproduce the water by merely combining its chemical components. In other words, the analysis of the water cannot serve as a basis from which to prepare it, because even though all of the components were put together many would be found insoluble and others would form new chemical combinations, so that the result would differ widely from the mineral water imitated.

For example, carbonate of magnesia and carbonate of lime, which are important ingredients in most mineral waters, will not make a clear solution unless freshly precipitated; hence, when these are to be reproduced in a mineral water it is customary to employ other substances which will dissolve at once, and which will, upon combining, produce these salts. The order in which the salts are added is also a very important matter, or by dissolving the salts separately and then carefully combining them, solutions may be effected which would be impossible were all the salts added together to the water in the portable fountain.

Formulas for various waters follow:

Formulas.

The formulas given below are for making 10 gallons of mineral water—*i.e.*, a sufficient quantity to charge the ordinary 10-gallon portable fountain. For the sake of convenience the different groups of substances in the formulas are separated by dashes. All the components above the first dash must be mixed together as directed in the first part of this article, and must then be added to the 10 gallons of water in the portable fountain, rocking the fountain all the while to secure a thorough mixture. The ingredients above the second dash must afterward be combined together and added to the fountain; and so on with each of the other groups in turn. The formulas given are designed to produce a very close imitation of the natural waters. Less elaborate formulas, which merely approximate the principal ingredients in the natural waters, are frequently used, and a few of these are given at the end of this section.

Apollinaris.—Sodium carbonate, 2.835.27 gr.; sodium sulphate, 335.2 gr.; sodium silicate, 10 gr.

Magnesium chloride, 198.1 gr.; calcium chloride, 40.2 gr.

Potassa alum, 57.1 gr.

Magnesium carbonate, hydr., 158.5 gr.

Iron sulphate, 21.3 gr.

Deep Rock.—Sodium chloride, 1,504.8 gr.; potassium chloride, 1,490.8 gr.; sodium silicate, 1,458 gr.; sodium carbonate, 521.1 gr.

Magnesium chloride, 102.5 gr.; calcium chloride, 202 gr.; hydrochloric acid, 257.4 gr.

Kissingen.—Sodium phosphate, 3.6 gr.; sodium silicate, 16.1 gr.; sodium chloride, 2,776.4 gr.; potassium chloride, 176.2 gr.; sodium bromide, 5 gr.; sodium nitrate, 57 gr.; ammonium carbonate, 1.6 gr.; sodium carbonate, 1,986.7 gr.

Lithium chloride, 12.2 gr.; calcium chloride, 960 gr.; magnesium chloride, 14.9 gr.

Magnesium sulphate, 1,213.8 gr.

Iron sulphate, 46.1 gr.

Saratoga Vichy.—Sodium carbonate, 4,249.8 gr.; sodium chloride, 112.2 gr.; potassium chloride, 141.1 gr.; sodium bromide, 9.9 gr.; sodium silicate, 15.4 gr.

Lithium carbonate, 11 gr.

Calcium chloride, 736.3 gr.; magnesium chloride, 307.9 gr.; barium chloride, 6.2 gr.; aluminum chloride, 12.5 gr.

Iron chloride, 0.39 gr.

The foregoing formulas are designed to give imitations as closely as possible to the analyses of the natural water, the analyses of the best chemists having been taken in every case. As in many cases the composition of the waters of the mineral springs differs at different seasons of the year, the mean or average of several analyses has to be taken as a standard.

In cases where a close reproduction of the natural waters is not required, much simpler formulas may be used, as for example in the three formulas given below:

Kissingen. — Sodium bicarbonate, 1 dram; sodium chloride, 8 oz.; ammonium chloride, 4 gr.; sodium sulphate, 2 dr. 2 scr.; magnesium sulphate, 2 oz.; magnesium carbonate, 4 dr. 1 scr.; water 2½ pt. Add to 10 gallons of water in a portable fountain and charge to 150 pounds.

Selters.—Calcium chloride, 0.27 gram; magnesium chloride, 0.8 gram; sea salt, 0.23 gram; sodium phosphate, 0.27 gram; iron sulphate, 0.013 gram; sodium sulphate, 0.4 gram; water, 605 grams. Charge to 150 pounds pressure.

Vichy.—Sodium chloride, 6 drams; sodium bicarbonate, 5.25 oz.; ammonium carbonate, 10 gr; sodium phosphate, 25 gr.; sodium sulphate, 4 scr.; potassium sulphate, 2 drams. Mix in half a gallon of water, and filter after standing twelve hours.

This solution may be kept a certain length of time, and when required be added to 10 gallons of water in the portable fountain and charged to 150 pounds pressure.

N. B.—In the case of these last three mineral water solutions it is desirable to shake the solution thoroughly before adding it to the water in the portable fountain.

COLORING AGENTS

No aniline colors whatever should be used in coloring any preparation for internal use, as they are liable to be harmful in themselves, and also in many instances to be contaminated with poisons used in the processes of making them.

Alkanet. — Deodorized alcohol, 800 parts; ground alkanet root, 200 parts. Mecerate, express and filter.

Black.— Sugar-black Paste. — Coal black (Kohlschwarz), 3 parts; grape sugar, 1 part; water, 6 parts.

Blue.—Sap-blue Paste. — Dark blue, 3 parts; grape sugar, 1 parts; water, 6 parts.

Caramel. — Heat three pounds of crushed sugar in a kettle with one pint of water. At first the sugar will dissolve, but after a while it will again solidify into a firm mass, which must be broken up. When the pieces have again become liquefied the mass becomes dark-colored and begins to foam, necessitating constant stirring. Continue to cook over a slow fire until the mass becomes very dark, then remove the kettle from the fire and pour in slowly three pints of boiling water, replace on the fire and boil again a few moments, then remove and cool. Add simple syrup to required consistency.

Carmine.—1.—Carmine, 5 parts; dextrin, 1 part; water, 4 parts.

2.—Carmine, finely powdered, 300 gr.; stronger aqua ammonia, 6 fl.dr.; glycerine, 3 fl.oz.; water, 30 fl.oz. Dissolve the carmine in the ammonia water and add the glycerine; now warm the solution until all odor of ammonia has disappeared. The water is then added.

3.—Carmine No. 40, 1 part; stronger ammonia water, 4 parts; distilled water sufficient to make 24 parts. Rub up the carmine in the ammonia water and to the solution add the water. If on standing the carmine shows a tendency to separate out, a drop or two of ammonia will correct the trouble. This statement should be put on the label of the bottle, as the volatile ammonia soon escapes, even in stoppered vials.

Curcuma. — Deodorized alcohol, 600 parts; water, 200 parts; ground curcuma, 200 parts. Macerate, express and filter.

Grass.—Deodorized alcohol, 680 parts; blue (or lawn) grass, 320 parts. Chop the grass fine and cover with the alcohol; let macerate for 24 hours, express and filter.

Green.—1.—The base for green colorings is saffron tincture, which see. The complementary color used to give the green is an aqueous solution of indigocarmine paste. Small amounts of the latter solution are added to the tincture until the desired shade of green is obtained.

2.—Carmine Green.—Woodruff (Waldmeister) green, 55 parts; Rosa II., 5 parts; dextrin, 35 parts; potato flour, 5 parts.

Orange.—Tincture of red sandalwood, 1 part; ethereal tincture of orlean, q. s. Add the tincture of orlean to the sandalwood tincture until the desired shade of orange is obtained.

A red added to any of the yellows gives an orange color.

Pink.—1.—Carmine, 1 part; liquor potassae, 6 parts; rose water, enough to make 48 parts. Mix. Should the color be too high, dilute with water until the requisite tint is acquired.

2.—Soak red apple parings in California brandy. The addition of rose leaves makes an exquisite flavoring as well as coloring agent.

Raspberry.—Extract of annatto, 8 av.oz.; water, 16 fl.oz.; alcohol, 8 fl.oz.; tartaric acid, 150 gr. Dilute caramel solution, q. s. Mix the extract of annatto, water, alcohol and the tartaric acid. When solution is effected, add a sufficient quantity of the caramel solution to give the liquid a rich raspberry color.

Red.—1—.A fine red color may be given to syrups by black cherry juice or black raspberry juice, and these are, of course, unobjectionable, if free from antiseptics.

2.—Cinnabar Red.—Scarlet, 65 parts; white dextrin, 30 parts; potato flour, 5 parts. For every 4 lb. 4½ oz. add a grain and a half each of potassium iodide and sodium nitrate.

3.—Cochineal.—a.—Powdered cochineal, 1 av.oz.; potassium carbonate, 2 av. oz.; water, 26 fl.oz.; cream of tartar, 6 av.oz.; alum, ½ av.oz. Dissolve the potassium carbonate in the water, and add this solution to the powdered cochineal; let the mixture macerate for two days. Then add the cream of tartar and the alum; when effervescence has ceased, pour on a filter, and wash the residue with sufficient hot water to make the filtrate measure 30 fl.oz., then add 2 fl.oz. of alcohol.

b.—Cochineal in coarse powder, 6 parts; potassium carbonate, 2 parts; distilled water, 15 parts; alcohol, 12 parts; simple syrup enough to make 500 parts. Rub up the potassium carbonate and the cochineal together, adding the water and alcohol little by little under constant trituration. Set aside over night, then add the syrup and filter.

c.—Cochineal, in No. 50 powder, 60 grams; potassium carbonate, 30 grams; alum, 30 grams; potassium bitartrate, 60 grams; glycerine, 500 c.c.; alcohol, 30 c.c.; water, a sufficient quantity to make 1,000 c.c. Triturate the cochineal intimately with the potassium carbonate and 500 c.c. of water; then add the alum and potassium bitartrate successively, heat the mixture to boiling in a capacious vessel, set aside to cool, add to it the glycerine and alcohol, filter, and pass enough water through the filter to make 1,000 c.c. Yellow may be obtained by infusing safflower in water.

Red Saunders.—Deodorized alcohol, 800 parts; ground red saunders, 200 parts. Macerate, express and filter.

Rose.—a.—Bluish Rose.—Grenadin, 65 parts; white dextrin, 30 parts; potato flour, 5 parts. For every 4 pounds 4½ ounces, add 1½ grains each of potassium iodide and sodium nitrate.

b.—Yellowish Rose.—Rosa II., 60 parts; citron-yellow, 5 parts; white dextrin, 30 parts; potato flour, 5 parts.

Saffron Tincture.—Saffron, 3 oz.; water, 1 qt.; alcohol, 1 qt. Add the saffron to the diluted alcoholic menstruum. Macerate for several days in a moderately warm place, then cool and filter.

Violet.—Red-violet, 65 parts; white dextrin, 30 parts; potato flour, 5 parts.

Yellow.—1.—Ground fustic wood, 1½ oz.; deodorized alcohol, 4 fl.oz.; distilled water, 4 fl.oz. This color may be made in the same manner as the liquid saffron, and is a fine coloring for many purposes.

2.—Turmeric powder, 2 oz.; alcohol, dilute, 16 oz. Macerate for several days, agitating frequently, and filter. For some beverages the addition of this tincture is not to be recommended, as it possesses a very spicy taste.

3.—Pastille Yellow.—Citron-yellow II., 7 parts; grape sugar, first quality, 1 part; white dextrin, 2 parts.

ESSENCES AND EXTRACTS

ESSENCE.—An oil distilled at a comparatively low temperature from a plant in which it already exists; as, *essence* of peppermint.—*Century Dictionary.*

EXTRACT.—Anything drawn from a substance by distillation, heat, solution, or other chemical process, as an essence or tincture.—*Century Dictionary.*

Allspice.—1.—Allspice, coarsely ground, 4 oz.; diluted alcohol, 1 pt.

2.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of allspice, 100 parts; carbonate of magnesia, 100 parts. Color with caramel.

Almonds.—1.—One fl.oz. essential oil of almonds, 1 pt. spirit; proceed as allspice.

2.—Essence of bitter almonds, essence of peach kernels, almond flavor. Essential oil of almonds, 1 fl.oz.; rectified spirit (56 o.p.), 19 fl.oz. Mix and agitate them together until united.

3.—Concentrated essence of almonds, double E. of A. Take of essential oil of almonds, 1 fl.oz.; alcohol, strongest, 9 fl.oz. Mix. Used chiefly to impart the nutty aroma and flavor of bitter almonds and peach kernels to other preparations. The first is the common essence of the shops. Essences of other essential oils may be prepared in a similar manner. Many of them are now much used by confectioners and cooks, as well as in perfumery and cosmetics. It should be remembered that essence of almonds is poisonous.

4.—Oil of bitter almonds, 1 oz; alcohol, 13 oz.; water, 6 oz. Some color it with half an ounce of tincture of turmeric.

Angelica.—1.—Angelica root, 2 oz.; rectified spirit, 2½ oz.; water, 9 oz. Digest, strain and evaporate.

2.—Angelica root, 2 lb.; rectified spirit, 1 gal.; make a tincture; to the marc add 1 gal. proof spirit and repeat the digestion; filter the two tinctures separately, mix, distil off the spirit, and evaporate.

Anise.—1.—Aniseed, 2 oz.; oil of star anise, 1 oz.; alcohol, 2 pt.

2.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of anise, 100 parts; carbonate of magnesia, 100 parts. Color with caramel.

Apples.—1.—Peel and reduce to pulp, 6 lb. unripe crab apples; add 1 lb. iron wire in small coils; digest in a vapor bath for about a week, express, strain, decant and evaporate in a porcelain vessel, with constant stirring, to the consistency of a soft extract; dissolve the residue in 4 parts water, strain and evaporate as before.

2.—Deodorized alcohol, 500 parts; pure apple brandy, 400 parts; apple ether, 100 parts. Color with tincture of red saunders.

3.—Glycerine, 1 oz.; amyl valerianate, 4 drams; linalyl formate, 45 m.; fld. ext. orris, 1 oz.; alcohol, 11 oz.; water, q.s. ad., 1 pt.

4.—Conc. ess. of apple peel, 720 parts; valerianate of amyl, 120 parts; acetic ether, C. P., 80 parts; nitric ether, 80 parts.

Apricot.—1.—Butyric ether, 10 parts; valerianic ether, 5 parts; glycerine, 4 parts; amylic alcohol, 2 parts; amylbutyric ether, chloroform, enanthic ether, and tartaric acid, each 1 part.

2.—Linalyl formate, 90 m.; glycerine, 1 oz.; amyl valerianate, 4 drams; alcohol, 11 oz.; fl. ext. orris, 1 oz.; water, q. s. ad., 1 pt.

3.—Alcohol, 400 parts; conc. ess. of apricot peel, 360 parts; butyrate of amyl, 200 parts; oil of bitter almond, 40 parts.

Banana.—1.—Banana essence, 2 oz.; citric acid, 1 oz.; alcohol, 70°, 2 pt.

2.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure banana juice, 190 parts; banana ether, 100 parts; tincture of vanilla, 10 parts. Color with tincture of curcuma.

3.—Acetate of amyl, 1 oz; valerianate of ethyl, 1 dram; diluted alcohol, 15 oz.

4.—Amyl acetate, 4 drams; alcohol, 10 oz.; water, enough to make 16 oz. Some add butyric ether, which, however, is of questionable utility.

5.—Alcohol, 430 parts; conc. ess. of banana peel, 400 parts; butyrate of amyl, 100 parts; butyric ether, 50 parts; chloroform, 10 parts; aldehyde, 10 parts.

Bergamot.—Alcohol, 780 parts; pineapple ether, 200 parts; oil of bergamot, 20 parts.

Birch.—1.—First cut the oil. The essence is made as follows: Oil of birch or wintergreen, 1½ oz.; alcohol, 95°, 12 oz.; water, 12 oz.

2.—Sassafras, 1 oz.; wildcherry bark, ½ oz.; pimento, 1 oz.; wintergreen, 1 oz.; hops, ¼ oz.; coriander seed, ½ oz. Percolate with diluted alcohol until 10 ounces of tincture are obtained. The "extract" is added to plain mineral water when drawn, in the proportion of a half a teaspoonful more or less to an ordinary glass.

Blackberry. — 1. — Apple oil, 1 oz.; quince oil, 1 oz.; tincture of orris, 1 oz.; tartaric acid, 1 oz.; alcohol, 70°, 2 pt.

2.—Tincture of orris root (1 to 8), 1 pt.; acetic ether, 30 drops; butyric ether, 60 drops.

3. — Blackberry. — Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure blackberry juice, 170 parts; blackberry ether, 100 parts; essence of cinnamon, 10 parts; essence of coriander, 10 parts; essence of nutmeg, 10 parts.

4.—Alcohol, 500 parts; conc. ess. of blackberry, 400 parts; acetic ether, C. P., 50 parts; formic ether, 20 parts; butyrate of amyl, 20 parts; acetate of amyl, 10 parts.

Blueberry.—Alcohol, 420 parts; conc. ess. of blueberry, 400 parts; acetic ether,

C. P., 60 parts; benzoic ether, 60 parts; enanthic ether, 40 parts; pelargonic ether, 20 parts.

Cacao.—Deodorized alcohol, 500 parts; proof spirits, 100 parts; powdered cacao, 300 parts; powdered vanilla, 50 parts; powdered cinnamon, 45 parts; ambergris, 5 parts. Macerate for two weeks, express and filter.

Calamus. — Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of calamus, 100 parts; carbonate of magnesia, 100 parts.

Caraway. — Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of caraway, 100 parts; carbonate of magnesia, 100 parts. Color with tincture of grass.

Cardamom.—1.—Cardamom seeds, 600 gr.; alcohol at 85°, 10.5 liters; water, 5 liters. Product, 10 liters.

2.—Deodorized alcohol, 500 parts; proof spirits, 400 parts; oil of cardamom, 50 parts; carbonate of magnesia, 50 parts.

Cassia.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of cassia, 100 parts; carbonate of magnesia, 100 parts. Color with tincture of red saunders.

Catechu (Cachou). — Catechu, 600 grams; alcohol, 85°, 10.5 liters; water, 5 liters. Product, 10 liters.

Cedrat.—Rinds of 60 fresh citrons; alcohol, 12 liters. Macerate for twenty-four hours; at the time of distilling add 5 liters of water and distill; draw off 11 liters. Rectify with 5 liters of water. Product, 10 liters.

Celery.—1.—Bruised celery seed, 4½ oz.; proof spirit, 1 pt.; digest 14 days, strain.

2.—Celery seed, 7 oz; rectified spirit, 1 pt.; digest and strain as 1.

3.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of celery, 100 parts; carbonate of magnesia, 100 parts.

Cherry.—1.—Oil of bitter almonds, 2 drams; apple oil, 1 oz.; citric acid, 1 oz.; alcohol, 70°, 2 pt.

2.—Black.—a.—Benzoic ether, 5 parts; acetic ether, 10 parts; oil of persico (peach kernels) and benzoic acid, each 2 parts; citric acid, 1 part.

b.—Alcohol, 550 parts; conc. ess. of black cherry, 400 parts; acetate of amyl, 25 parts; oil of bitter almond, 10 parts; butyrate of amyl, 8 parts; oil of citron, 2 parts; oil of cinnamon, 2 parts; oil of clove, 2 parts; oil of sweet orange, 1 part.

3.—Morella Cherry.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure morella cherry juice, 160 parts; morella cherry ether, 100 parts; carbonate of magnesia, 20 parts; oil of bitter almond, 10 parts; oil of lemon, 4 parts; oil of sweet orange, 2 parts; oil of cinnamon, 2 parts; oil of cloves, 2 parts.

4.—Wild Cherry.—a.—Wild cherry in fine powder, 16 oz.; glycerine, 4 oz.; water, 8 oz.; mix the glycerine and the water, and digest the wild cherry in 8 oz. of the mixture for four days; pack in a percolator and pour on the remaining 4 oz. glycerine and water; when this has disappeared from the surface, pour on rectified spirit (0.817) until 12 oz. of fluid have been obtained, and set this portion aside. Then percolate with spirit until 20 oz. more have been obtained; evaporate to 4 oz. and mix with the reserved portion.

b.—Deodorized alcohol, 500 parts; proof spirits, 250 parts; powdered wild-cherry bark, 250 parts. Macerate for two weeks, express and filter. Color with caramel.

c.—Acetic ether, 5 fl.dr.; benzoic ether, 5 fl.dr.; enanthic ether, 1 fl.dr.; oil of bitter almond (deprived of hydrocyanic acid), 2 fl.dr.; saturated alcoholic solution of benzoic acid, 1 fl.dr.; glycerine, 4 fl.dr.; deodorized alcohol, enough to make 16 fl.oz.

Cinchona.—Yellow cinchona bark in coarse powder, 16 oz.; sufficient distilled water; rectified spirit, 1 oz. Macerate the bark in 40 oz. water for twenty-four hours, pack in a percolator and add water until 240 oz. have passed through, or until the bark is exhausted; evaporate the liquor to 20 oz. at a temperature not exceeding 160° F. (71° C.); filter and continue the evaporation to 3 oz., or until the sp. gr. of the liquid is 1.200; when cold add the spirit gradually, constantly stirring.

Cinnamon.—1.—Oil of cinnamon, 2 drams; Ceylon cinnamon, bruised, 4 oz.; diluted alcohol, 2 pt.

2.—Cinnamon, pulverized, 300 grams; alcohol, 85°, 10.5 liters; water, 5 liters. Macerate for twenty-four hours, distil over open fire. Rectify the product with 5 liters water over an open fire—product, 10 liters.

Citron.—Alcohol, 700 parts; pineapple ether, 200 parts; oil of citron, 100 parts.

Cloves.—1.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of cloves, 100 parts; carbonate of magnesia, 100 parts. Color with caramel.

2.—Powdered clove, 4 oz.; diluted alcohol, 1 pt.

Cocoa.—Dissolve 1 lb. of chocolate in a quart of boiling water, let it cool; take out the cocoa butter and add to it 4 oz.

of glycerine and bottle. For flavoring ice cream.

Coffee.—1.—Pour upon a pound of the best fresh roasted coffee 1 qt. of cold water, heat gently for half hour, then let it come to a boil, cool for two hours, strain and add 4 oz. of glycerine.

2.—For Dispensing (Liebig's).—Pour 1 qt. boiling water on 2 lb. of best ground coffee; allow it to stand one hour, place in a percolator; add enough water to obtain 32 fl.oz. of extract; add 2 oz. of alcohol to preserve, or more alcohol if intended to keep a long time.

3.—For Dispensing.—Ground Java coffee, 8 oz.; sliced vanilla bean, 2 drams; diluted alcohol, q. s.

4.—Ground roasted coffee, 2 to 8 oz.; cinnamon, bruised, 60 gr.; vanilla, sliced, 60 gr.; diluted alcohol, q. s. Moisten the ingredients with some of the liquid and pack in percolator. Put in enough diluted alcohol to leave a stratum above it. Macerate for forty-eight hours, covered; percolate, pour on enough diluted alcohol until 32 fl.oz. of extract is obtained.

5.—From 1 part of ground coffee and the necessary quantity of boiling water make a decoction that after filtration consists of ½ part by weight of fluid. This with the addition of 0.2 part sugar is evaporated in a shallow dish at a temperature of at the highest 140° F. to such an extent that a sample dropped on a glass plate on cooling becomes a solid mass. The fluid is then poured into molds that give the solidified pieces the form of tablets and these are wrapped in tinfoil or paraffined paper.

6.—Mocha coffee, ¾ lb.; Java coffee, ½ lb.; hot water, sufficient to make 2 qt. Grind the coffee to a moderately fine powder. Moisten with the hot water and pack in a glass funnel or preferably in a cylindrical percolator and percolate by pouring on boiling water in divided portions until two quarts of percolate are obtained.

7.—Mocha coffee, 4 parts; "Old Government" Java coffee, 8 parts; Rio coffee, 4 parts; glycerine, 3 parts; water, enough. The coffee should be freshly roasted and reduced to a moderately fine powder. Put into a vessel provided with a tightly fitting cover, and pour over it 10 parts of boiling water to which the glycerine has been added. Put on the cover and close tightly. Now wrap the vessel in a blanket or felt, to preserve the heat as long as possible, and set away in a warm place one hour and a half. At the expiration of this time pack into a percolator and exhaust with boiling water until 32 parts of percolate are obtained.

Coriander.—1.—Coriander seeds, 12 kilo 500 gr.; alcohol, 10.50 liters; water, 5 liters—product, 10 liters.

2.—Powdered coriander, 4 oz.; oil of coriander, 1 dram; alcohol, 24 oz.; water, 8 oz.

Cranberry.—Alcohol, 400 parts; conc. ess. of cranberry, 300 parts; raspberry ether, 200 parts; acetic ether, C. P., 50 parts; French wine vinegar, 20 parts; formic ether, 20 parts; benzoic acid, 10 parts.

Cumin.—Cumin seeds, 1 kilo 250 gr.; alcohol at 85°, 10.50 liters; water, 5 liters—product, 10 liters.

Currant.—1.—Acetic ether, tartaric acid, each 5 parts; benzoic acid, succinic acid, benzoic ether, aldehyde and enanthic acid, each 1 part.

2. — Black. — Raspberry ether, 500 parts; conc. ess. of black currant, 400 parts; acetic ether, C. P., 100 parts.

3.—Red.—a.—Raspberry ether, 900 parts; acetic ether, 80 parts; French wine vinegar, 20 parts.

b.—Acetic ether, 5 parts; benzoic ether, 1 part; aldehyde, 1 part; acetic acid, 1 part; benzoic acid, 1 part; enanthic ether, 1 part; raspberry essence, 10 parts; deodorized alcohol, q. s. to make 100 parts. Mix. The above is rendered much finer by the addition of 20 parts of pure fresh currant juice.

Fennel.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of fennel, 100 parts; carbonate of magnesia, 100 parts. Color lightly with tincture of red saunders.

Foam Extract.—Crushed soap bark, ½ lb.; alcohol, ½ pt.; glycerine, ½ pt.; water, 1 pt. The bark should be saturated with 3 oz. of the mixture of alcohol, glycerine and water. Pack in a percolator, close the lower orifice; a enough liquid to leave a stratum above the bark; then macerate for twenty-four hours, and percolate; add of alcohol, glycerine and water in the above proportions enough to obtain 1 qt. of extract.

The proportions are from 1 dram to ½ oz. to 2 qt. of syrup, according to the foam desired on the beverage.

Fruit Essences.—Dingler's Polytechnic Journal gives the following table of the composition of artificial fruit essences, showing the number of parts of each ingredient to be added to 100 parts of alcohol—all chemically pure. Glycerine is found in all—it appears to blend the different odors, and to harmonize them:

	Peach.	Apricot.	Plum.	Cherry.	Black Cherry.	Lemon.	Pear.	Orange.	Apple.	Grape.	Gooseberry.	Raspberry.	Strawberry.	Melon.	Pineapple.
Glycerine	5	4	8	3		5	10	10	4	10		4	2	3	3
Chloroform		1				1		2	1	2					1
Nitric Ether						1			1			1	1		
Aldehyde	2		5			2		2	2	2	1	1		2	1
Acetate of Ethyl	5		5	5	10	10	5	5	1		5	5	5		
Formiate of Ethyl	5		1					1		2		1	1	1	
Butyrate of Ethyl	5	10	2					1				1	5	4	5
Valerianate of Ethyl	5	5												5	
Benzoate of Ethyl				5	5			1			1	1			
Enanthylate of Ethyl	5	1	4	1	2					10	1	1			
Sebacic Ether	1											1		10	
Salicylate of Methyl	2	2						1		1		1	1		
Acetate of Amyl							10	10				1	3		
Butyrate of Amyl		1										1	2		10
Valerianate of Amyl						10			10						
Essence of Orange								10							
Alcoholic solutions saturated in the cold of— Tartaric Acid						10		1		5	5	5			
Citric Acid		1			1				1						
Succinic Acid						1				3	1	1			
Benzoic Acid				1	2						1				

Ginger.—1 (Creuse's Process).—Fluid extract of ginger, 1½ pt.; water, 3 pt.; carbonate of magnesia, 3 oz. Mix, shake often for 24 hours, filter, evaporate to ¾ pint and add ¾ pt. alcohol.

2.—Jamaica ginger, fine powdered, 6 oz.; alcohol, 2 pt. Moisten powder with ½ pt. of alcohol and allow it to maccerate for 24 hours. Pack in percolator and gradually pour menstruum on it until 2 pt. are obtained of this extract. Use 3 oz. to 1 gal. simple syrup and 1 oz. foam.

3.—Ginger, unbleached, 4 oz.; calamus, 2 drams; Canada snake root, 2 drams; cinnamon, mace and cloves, of each 2 drams; alcohol, 85 per cent., sufficient to make 16 oz. Dextrin syrup is the article familiarly known as "glucose." Its use is deemed preferable to cane sugar in mixture, owing to the gum it contains and the body given to the preparation without excessive sweetness.

4.—Deodorized alcohol, 500 parts; proof spirits, 250 parts; powdered Jamaica ginger, 250 parts. Macerate for two weeks, express and filter.

5.—Grated ginger, 3 oz.; fresh lemon peel, 2 oz., digested in 1½ pt. brandy for ten days.

6.—Equal parts best unbleached Jamaica ginger in coarse powder, and silicious sand, sprinkled with enough rectified spirit of wine to perfectly moisten; after 24 hours the mass is placed in a percolator, and after returning the first runnings two or three times, the receiver is changed and more rectified spirit is poured on gradually and at intervals as required until as much essence is obtained as there has been ginger employed.

7.—Twelve lb. best unbleached Jamaica ginger in coarse powder digested in 2½ gal. rectified spirit for fourteen days; the expressed and strained tincture is reduced by distillation in a steam or water bath to 1 gal., cooled, transferred rapidly to stoppered bottles and filtered.

8.—Twenty-four lb. ginger as in 7, 6 gal. rectified spirit; make a tincture as before, and distil down to 1 gal.; cool as quickly as possible out of contact with the air and add 1 gal. strongest rectified spirit of wine; filter if necessary.

9.—Causes no turbidity with water or syrup. 1 lb. finest Jamaica ginger in powder, macerated in 8 oz. rectified spirit for several hours; add more spirit and percolate to 16 oz.; add 2 oz. heavy carbonate of magnesia, agitate and add 24 oz. water; shake well and filter. If the filtrate is turbid, shake up with more magnesia and filter again. It becomes turbid again after a few days' rest, but on filtering continues clear.

Gooseberry.—Aldehyde, 1 part; acetic ether, 5 parts; benzoic ether, 1 part; enanthic ether, 1 part; tartaric acid, saturated solution, 1 part; benzoic acid, saturated solution, 1 part; alcohol (deodorized), q. s. to make 100 parts.

Grape.—1.—Chloroform, 2 parts; aldehyde, 2 parts; formic ether, 2 parts; enanthic ether, 10 parts; methyl-salicylic ether, 1 part; tartaric acid, saturated solution, 5 parts; succinic acid, saturated solution, 3 parts; glycerine, 10 parts; alcohol (deodorized), q. s. to make 100 parts. Mix.

2.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; pure catawba grape juice, 140 parts; acetic ether, 30 parts; butyric ether, 15 parts; oil of bitter almond, 10 parts; cognac oil, 5 parts.

3.—Enanthic ether, glycerine, each 10 parts; tartaric acid, 5 parts; succinic acid, 3 parts; aldehyde, chloroform and formic ether, each 2 parts, and methyl-salicylic ether, 1 part.

4.—Alcohol, 440 parts; Rhine wine, 400 parts; enanthic ether, 100 parts; chloroform, 20 parts; formic ether, 20 parts; aldehyde, 20 parts.

Juniper Berries.—1.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of juniper berries, 100 parts; carbonate of magnesia, 100 parts.

2.—Dissolve ¾ oz. of oil of juniper in 3 pt. of rectified spirit, 90 per cent. Filter.

Kola Essence.—The *Ap. Ztg.* gives this formula: Kola, in coarse powder, 75; confection orange, 50; vanilla, 2; Ceylon cinnamon, 10; Muscatel or port wine, 400; alcohol, 500. Mix and macerate eight days, express and filter into a solution of sugar, 250; water, 400.

Lavender.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of Mitcham lavender, 100 parts; carbonate of magnesia, 100 parts; color with tincture of red saunders.

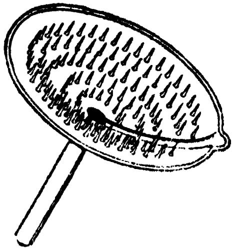
Lemon.—1.—Oil of lemon, acetic ether and tartaric acid, each 10 parts; glycerine, 5 parts; aldehyde, 2 parts; chloroform nitrous ether and succinic ether, each 1 part.

2.—One-half lb. yellow peel of fresh lemons, ½ gal. boiling water; infuse one hour, express the liquor, boil down to ½ pt., cool and add ¼ oz. oil of lemon dissolved in 1½ pt. spirit of wine; mix and filter.

3.—Citral, 1 oz.; oil lemon, 15 oz.; cologne spirit, 3 gal.; water, 2 gal.

4. Deodorized alcohol, 500 parts; proof spirits, 250 parts; oil of lemon, 100 parts; carbonate of magnesia, 100 parts; pineapple ether, 50 parts. Color with tincture of curcuma.

5.—White sugar, 600 grams; distilled water, 400 grams; citric acid, 40 grams; orange flower water, 100 grams; alcohol, 100 grams; oil lemon, 10 grams. Dissolve the sugar in the water and to the syrup add the citric acid dissolved in the orange flower water. Filter and add the oil of lemon dissolved in the alcohol. To make lemonade add 100 grams of this essence to 1 liter of water or carbonated water.



The Ecuelle, for rupturing the oil vessels of citrus fruits

6.—Alcohol, 700 parts; pineapple ether, 200 parts; oil of lemon, 100 parts.

7.—Oil of lemon, 1½ fl.oz.; alcohol, 14½ fl.oz.; turmeric, q. s. to color. Filter through a little carbonate of magnesia if necessary.

A cheaper article can, of course, be made by using less oil and adding about 25 per cent. of water. It is scarcely necessary to add that a fine article can be made only from *fresh* oil.

8.—Oil of lemon, select, 8 fl.oz.; oil of lemon-grass (fresh), 1 fl.dr.; peel, freshly grated, of 12 lemons; alcohol (Atwood's), 7 pt.; water, boiled, 1 pt. Mix and macerate for 7 days. If in a hurry for the product, percolate through the lemon peel and filter.

Lime.—1.—Deodorized alcohol, 500 parts; proof spirits, 250 parts; oil of lime fruit, 100 parts; carbonate of magnesia, 100 parts; pineapple ether, 50 parts. Color lightly with tincture of curcuma.

2.—Dissolve ½ oz. of oil in 15½ oz. of alcohol, making just a pint of finished product.

Mace.—Deodorized alcohol, 500 parts; proof spirits, 350 parts; powdered mace, 150 parts. Macerate for two weeks, express and filter.

Malt.—1.—An infusion of malt is made in water at 160 to 170° F. (71 to 77° C.), drained off without pressure and evaporated to a honeylike consistency. The quantities are 1 pt. crushed malt in 3 pt. hot water and the infusion occupies about four hours.

2.—47½ oz. extract of malt, mixed with 1 oz. iron pyrophosphate and ammonia citrate dissolved in 1½ oz. water.

3.—Six oz. coltsfoot leaves, 6 oz. spotted lungwort, 8 oz. licorice, 2 lb. stoned raisins, 6 gal. old strong ale, not hopped; boil down to 4 gal., express strongly and evaporate to honeylike consistency.

Mead.—Oil of lemon, 1 oz.; oil of cloves, 2 drams; oil of cinnamon, 2 drams; oil of nutmeg, 1 dram; oil of allspice, 30 drops; oil of sassafras, 40 drops; oil of ginger, 1 dram. Cut the oils with pumice and sugar; dissolve 16 or 32 oz. alcohol. Add gradually an equal quantity of water. Clarify.

Melon.—1.—Alcohol, 780 parts; sebacic ether, 100 parts; valerianic ether, 50 parts; butyric ether, 40 parts; aldehyde, 20 parts; formic ether, 10 parts.

2.—Sebacylic ether, 10 parts; valerianic ether, 5 parts; glycerine, 3 parts; butyric ether, 4 parts; aldehyde, 2 parts; formic ether, 1 part.

Mulberry. — Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure mulberry juice, 200 parts; mulberry ether, 100 parts.

Nectarine. — Extract of vanilla, 2 parts; essence of lemon, 2 parts; essence of pineapple, 1 part.

Nutmeg.—1.—Oil nutmeg, 2 drams; mace, powder, 1 oz.; alcohol, 95 per cent., deodorized, 32 oz. Dissolve the oil in the alcohol by agitation, add the mace, agitate, then stopper tightly and macerate 12 hours. Filter through paper. P. D.

2.—Deodorized alcohol, 500 parts; proof spirits, 400 parts; oil of nutmeg, 50 parts; carbonate of magnesia, 50 parts. Color lightly with caramel.

Orange.—1.—Oil of orange and glycerine, each 10 parts; aldehyde and chloroform, each 2 parts; acetic ether, 5 parts; benzoic ether, formic ether, butyric ether, amylacetic ether, methylsalicylic ether and tartaric acid, each 1 part.

2.—Alcohol, 700 parts; pineapple ether, 200 parts; oil of sweet orange, 100 parts.

3.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; oil of orange, 100 parts; carbonate of magnesia, 100 parts. Color with tincture of saffron.

4.—Pure oil of orange, 1¼ oz.; carbonate magnesium, 2 oz.; alcohol, 12 oz.; water, q. s. to make 2 pt. Dissolve oil of orange in the alcohol and rub it with the carbonate of magnesium in a mortar. Pour the mixture into a quart bottle and fill the bottle with water. Allow to macerate for a week or more, shaking every day. Then filter through paper, adding enough water through the paper to make filtrate measure 2 pints.

5.—Sweet orange peel, in moderately fine powder, 16 oz.; glycerine, 3 fl.oz.; alcohol, q. s.; water, q. s. Having mixed 14 fl.oz. alcohol with 2 fl.oz. glycerine, the peel is moistened in a Wedgwood mortar with 12 fl.oz. of this mixture. After standing 12 hours percolation is conducted in the usual manner. The percolation is finished with a mixture of 2 parts alcohol and 1 part water. Reserving the first 14 fl.oz., add 1 fl.oz of glycerine to the remainder, evaporate to 2½ fl.oz., which mix with the reserved portion. The author describes this preparation as possessing all the aroma of the orange peel. One fl.oz. mixed with 15 fl.oz. of syrup gives an excellent syrup. aurant. quite clear. By adding to a pint of simple syrup 4 fl.drms. of the extract and a few drops of solution of citric acid, a most delicately flavored and unfermentable syrup for mineral waters is produced.

6.—Four oz. fresh yellow rind of orange, ½ pt. rectified spirit, ½ pt. water; digest for a week, press, filter; add 1 qt. sherry.

7.—Valencia oranges, 1 doz.; alcohol, 2 pt. Carefully detach the yellow portion of the rind and macerate it for 10 days in the alcohol. Owing to the difficulty of procuring fresh oil of orange, this formula is generally preferred.

Peach.—1.—Oil of almonds, 3 dr.; pineapple oil, 3 dr.; tartaric acid. 3 dr.; alcohol, 80°, 1½ pt.

2.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure peach juice, 200 parts; peach ether, 100 parts. Color with tincture of red saunders.

3.—Formic ether, valerianic ether, butyric ether, acetic ether, glycerine and oil of persico, each 5 parts; aldehyde and amylic alcohol, each 2 parts; sebacylic ether, 1 part.

4.—Linalyl formate, 120 m.; amyl valerianate, 8 dr.; fld. ext. orris, 2 oz.; enanthic ether, 2 dr.; oil rue (pure German), 30 m.; chloroform, 2 dr.; glycerine, 2 oz.; alcohol, 70 per cent., to 3 pt.

5.—Amylic alcohol, 2 parts; aldehyde, 2 parts; acetic ether, 5 parts; butyric ether, 5 parts; formic ether, 5 parts; sebacic ether, 1 part; valerianic ether, 5 parts; glycerine, 5 parts; oil peach kernels, 5 parts; alcohol, 100 parts (all by measure).

Pear.—1.—Acetic ether, 5 oz.; acetate of amyl, 10 oz.; glycerine, 10 oz.; alcohol, 100 oz.

2.—Amyl acetate, 1 oz.; pear juice, 2 oz.; glycerine, 2 oz.; cologne spirit, 11 oz. Mix them and filter.

3.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure pear juice, 200 parts; pear ether, 100 parts. Color lightly with tincture of red saunders.

Peppermint.—1.—Oil of peppermint (Mitcham), 1 fl.oz.; rectified spirit, 1 pt.; mix by agitation. White. This is the usual strength of that sold in the shops. The corresponding preparation of the new Br. Ph., "spiritus menthae piperitae," has more than double this strength, being made with 1 fl.oz. of oil to 9 fl.oz. of rectified spirit.

2.—To the product of No. 1 (above) add about ½ oz. of herb peppermint, parsley leaves, spinach leaves, and digest for a week, or until sufficiently tinged; or agitate the essence with 10 or 12 gr. of sap green, previously rubbed down with about a teaspoonful of hot water. A delicate light green. The ignorant do not conceive it to be good and pure unless it has a pale greenish tint.

Used in toothache and to disguise foulness of the breath, but chiefly as a flavoring ingredient by confectioners, cooks and druggists. Peppermint (essence, water) is a great favorite in domestic and popular medicine as a remedy in flatulence, colic, nausea, sickness, etc., and to disguise the flavor of nauseous substances. The dose of the essence is 10 to 30 drops on sugar, or mixed up with a little water or wine; of the water a teacupful or more, at will. A few drops of the essence well agitated with ½ pint of cold water, form an extemporaneous peppermint water equal to that obtained by distillation. This water is an excellent mouth wash for smokers.

3.—One oz. oil of peppermint, 4 oz. rectified spirit; mix.

4.—To 3 add ½ oz. herb of peppermint, or parsley or spinach leaves (preferably one of the first two), digest for a week, or until sufficiently colored; 10 or 12 gr. sap green rubbed up with a teaspoonful of hot water is also used for coloring.

5.—Two fl.oz. of oil of peppermint, 16 fl.oz. rectified spirits.

Pineapple.—1.—Pineapple essence, 2 oz.; citric acid, 1 oz.; alcohol, 80°, 2 pt.

2.—Amyl butyric ether, 10 parts; butyric ether, 5 parts; glycerine, 3 parts; aldehyde and chloroform, each 1 part.

3.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure pineapple juice, 190 parts; pineapple ether, 100 parts; tincture of vanilla, 10 parts. Color with tincture of curcuma.

4.—Oil of lemon, 2 drams; butyric ether, 4 drams; acetic ether, 2 oz.; spirit of nitrous ether, 1 oz.; glycerine, 1 oz.; alcohol, 1 pt.; water, enough to make 2 pt.

5.—Amyl acetate, 1 part; amyl butyrate, 10 parts; ethyl butyrate, 5 parts; glycerine, 3 parts; oil lemon, 0.1 part; oil orange, 0.2 part; alcohol, 100 parts.

6.—Amyl butyrate, 4 drams; butyric ether, 2 oz.; sebacic ether, 4 drams; acetic ether, 2 drams; amyl acetate, 2 drams; pineapple juice, 2 oz.; glycerine, 2 oz.; cologne spirit, 12 oz. Mix them and filter. A very fair essence of pineapple is made by mixing 2 oz. of butyric ether with 12 oz. of cologne spirit. Mix them and filter.

7.—Pineapple Punch Essence.—Alcohol, 2 qt.; rum, 1 qt.; artificial pineapple essence, ½ fl.drm.; essence enanthic ether, 20 gr.; citric acid solution, 1 to 1½ fl.oz.; syrup, 2 qt.

Pistachio.—1.—Essence of almond, 2 fl.oz.; tincture of vanilla, 4 fl.oz.; oil of neroli, 1 drop.

2.—Oil of orange-peel, 4 fl.dr.; oil of cassia, 1 fl.dr.; oil of bitter almond, 15 m.; oil of calamus, 15 m.; oil of nutmeg, 1½ fl.dr.; oil of clove, 30 m.; alcohol, 12 fl.oz.; water, 4 fl.oz.; magnesium carbonate, 2 drams. Shake together, allow to stand 24 hours and filter.

3.—Oil orange, 45 m.; amyl acetate, 4 drams; oil bitter almonds, 5 drams; butyric ether, 5 drams; acetic ether, 9 drams; alcohol, 16 oz.; water to make 24 oz.

Plums.—1.—Glycerine, 8 parts; acetic ether and aldehyde, each 5 parts; oil of persico, 4 parts; butyric ether, 2 parts, and formic ether, 1 part.

2.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; German zwetschen water, 200 parts; plum ether, 100 parts.

Pomegranate.—Oil sweet orange, 3 parts; oil cloves, 1 part; tincture vanilla, 15 parts; tincture ginger, 10 parts; maraschino liqueur, 150 parts; tincture coccionella, 165 parts; distilled water, 150 parts; phosphoric acid, dilute, 45 parts; alcohol, 95 per cent., q. s. to make 1,000 parts. Mix and dissolve.

Quassia.—1.—Digest 1½ oz. sliced quassia in 1 pt. proof spirits for 10 days and filter.

Quince.—1.—Fluid ext. orris, 2 oz.;

enanthic ether, 1½ oz.; linalyl formate, 90 m.; glycerine, 2 oz.; alcohol, 70 per cent., to 3 pt.

2.—Alcohol, 460 parts; conc. ess. of quince peel, 400 parts; pelargonic ether, 100 parts; chloroform, 20 parts; aldehyde, 20 parts.

3.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure quince juice, 160 parts; quince ether, 100 parts; carbonate of magnesia, 20 parts; oil of cinnamon, 10 parts; oil of cloves, 10 parts. Color with tincture of saffron.

Raspberry.—1.—Raspberry essence, 3 drams; tincture of orris, ¼ oz.; citric acid, ¼ oz.; liq. carmine, 15 drops; extract rose (from pomade), ¼ oz.; alcohol, 85°, ½ pt.

2.—Butyric ether, 5 parts; acetic ether, 3 parts; nitrous ether, 1 part; glycerine, 2 parts; alcohol (deodorized), q. s. to make 100 parts. The addition of from 25 to 30 parts of fresh raspberry juice is recommended.

3.—Fresh raspberries, 200 grams; distilled water, 100 grams: vanilla essence, 2 grams; alcohol, sufficient. Pulp the raspberries, let stand at a temperature of about 70° for 48 hours, and then add 100 grams of water. Fifty grams are then distilled (?) off, and alcohol 90 per cent., 25 grams, in which 0.01 vanillin has been previously dissolved, is added to the distillate.

4.—Fresh raspberries, 16 oz.; Angelica (California), 6 oz.; brandy (California), 6 oz.; alcohol, 8 oz.; water, q. s. Marsh the berries to a pulp in a mortar or bowl and transfer to a flask, along with the Angelica, brandy, alcohol and about 8 ounces of water. Let macerate over night, then distil off until 32 ounces have passed over. Color red. The addition of a trifle of essence of vanilla improves this essence.

5.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure raspberry juice, 170 parts; raspberry ether, 100 parts; tincture of orris, 20 parts; triple extract of roses, 10 parts. Color with tincture of alkanet.

6.—Acetic ether and tartaric acid, each 5 parts; glycerine, 4 parts; aldehyde, formic ether, benzoic ether, butyric ether, amyl butyric ether, acetic ether, enanthic ether, methylsalicylic ether, nitrous ether, sebacylic ether and succinic acid, each 1 part.

Rhubarb.—1.—Sliced or bruised rhubarb, 8 oz.; rectified spirit, 5 oz.; distilled water, 50 oz. Macerate four days; strain and set to subside; decant the clear, strain, mix and evaporate to a proper consistency over a water bath at 160° F. (71° C.).

2.—Compound.—Extract rhubarb, 3 drams; extract of aloes, softened with 4 drams water, 1 dram; evaporate to an extract; dry in a warm place and powder.

3.—Rhubarb powder, 5 oz.; silicious sand, 5 oz.; proof spirit, 1 oz.; extract by displacement.

Root Beer.—Sassafras, 4 oz.; yellow dock, 4 oz.; allspice, 4 oz.; wintergreen, 4 oz.; wildcherry bark, 2 oz.; coriander seed, 2 oz.; hops, 1 oz. Reduce to powder and percolate with a menstruum composed of 3 volumes of alcohol and 5 volumes of water until 48 fl.oz. of liquid have passed. Of this half-strength fluid extract 2 fl.oz. are sufficient to make 1 gal. of root beer. Or exhaust the above drugs with the menstruum indicated, add enough water to make 6 gal., and start fermentation with 1 pt. of yeast.

Percolate the following ingredients with 2 parts of water to 1 part of alcohol until the drugs are exhausted: Sarsaparilla, 5 lb.; spikenard, 2 lb.; wintergreen, 1 lb.; birch bark, 1 lb.; sassafras bark, 1 lb.; wild cherry, 8 oz.; prickly ash, 1 lb.; Jamaica ginger root, 4 oz.; nutmeg, 4 oz.

Rose.—1.—Red rose leaves, 2 oz.; oil of rose, 1 dram; alcohol, 2 pt.

2.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; extract of rose geranium, 190 parts; otto of roses, 5 parts; carbonate of magnesia, 5 parts. Color with tincture of alkanet.

Sarsaparilla.—Oil of anise, 1 dram; oil of wintergreen, 2 drams; oil of sassafras, 3 drams; alcohol, enough to make 4 oz.

Sassafras.—1.—Deodorized alcohol, 500 parts; proof spirits, 400 spirits; oil of sassafras, 100 parts; carbonate of magnesia, 100 parts. Color with caramel.

2.—Oil of sassafras, 1 oz.; sassafras in coarse powder, 2 oz.; alcohol, 2 pt.

Savory Spices.—Black pepper, 4 oz.; powdered turmeric, 3 drams; coriander seeds (all ground), 1½ drams; oil of pimento, 1½ fl.dr.; oils of nutmeg, cloves, cassia and caraway, ½ dram each; rectified spirit, 1 pt.; digest with agitation for a fortnight.

Spearmint.—Deodorized alcohol, 500 parts; proof spirits, 400 parts; oil of spearmint, 50 parts; carbonate of magnesia, 50 parts. Color with tincture of grass.

Spice.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; carbonate of magnesia, 100 parts; oil of cassia, 40 parts; oil of bitter almond, 20 parts;

oil of cloves, 20 parts; oil of lemon, 10 parts; oil of neroli, 10 parts. Color with caramel.

Spruce.—Deodorized alcohol, 500 parts; proof spirits, 400 parts; oil of spruce, 50 parts; carbonate of magnesia, 50 parts. Color with caramel.

Strawberry.—1.—Pineapple oil, 1½ oz.; tincture of orris, ¾ oz.; tartaric acid, ¾ oz.; alcohol, 80°, 1½ pt.

2.—Butyric ether and acetic ether, each 5 parts; amyl-acetic ether, 3 parts; amyl-butyric ether and glycerine, each 2 parts; formic ether, nitrous ether and methyl-salicylic ether, each 1 part.

3.—Deodorized alcohol, 500 parts; proof spirits, 200 parts; pure strawberry juice, 140 parts; strawberry ether, 100 parts; pineapple ether, 45 parts; tincture of orris, 10 parts; tincture of vanilla, 5 parts. Color with tincture of alkanet and saffron.

4.—Raspberry ether, 840 parts; pineapple ether, 150 parts; tincture of orris, 5 parts; extract of vanilla, 5 parts.

5.—Oil of strawberry, ½ oz.; glycerine, ½ oz.; alcohol, 8 oz.; water, 7 oz. Dissolve oil in the alcohol, add the glycerine and then the water; mix well and filter.

6.—Oil of wintergreen, 1 part; nitrous ether, 1 part; acetic ether, 5 parts; butyric ether, 5 parts; glycerine, 2 parts; deodorized alcohol, 45 parts; distilled water, q. s. to make 100 parts.

7.—Acetic ether, 5 parts; butyric ether, 5 parts; nitrous ether, 5 parts; formic ether, 1 part; amyl acetate, 3 parts; amyl butyrate, 2 parts; tincture of orris root, 5 parts; oil of wintergreen, 1 part; acetate acid, 1 part; raspberry essence (see above), 10 parts; pineapple essence (see above), 5 parts; pure, fresh strawberry juice, 20 parts; deodorized alcohol, q. s. to make 100 parts. Mix.

Tea.—Extract the crushed tea-leaves with water and then distil the liquid in a vacuum. The first portion of the distillate, which contains the essential oil and other volatile flavor, is extracted with ether, and the oils are afterward mixed with the extract which remains in the still. Both the delicate and the heavier flavors are preserved in the extract in this way.

Tonic Beer Essence.—Oil of wintergreen, 6 drams; oil of sassafras and oil of orange, 6 drams of each; oil of anise, 30 gr.; oil of cloves, 30 gr. Cut the oils, dissolve in 20 fl.oz. alcohol, 95°; add gradually 20 fl.oz. water.

Tonka.—1.—Tonka bean, coarsely ground, 4 oz.; diluted alcohol, 1 pt.

2.—Tonka, 1 oz.; balsam peru, 2 drams; sugar, alcohol, water, of each a sufficient quantity. Reduce the beans and balsam of peru to a powder with magnesium carbonate and gradually add sugar to absorb the juice. Transfer to a percolator and cover with dilute alcohol. When the liquid appears at the exit cork the percolator and allow the maceration to progress for a period of 24 hours. Then remove the stopper and allow percolation to continue until 1 pint of extract has been obtained.

Vanilla.—1.—Cut up fine 1 oz. vanilla bean, grind with 2 oz. of loaf sugar, in a mortar, mix 8 oz. of rose water and 24 oz. of alcohol, 95°, add a portion to the vanilla and sugar, put in a displacer and pour on the balance of diluted alcohol. Add a few drops of caramel if not dark enough.

2.—Vanilla beans, sliced Mexican, 1 lb.; alcohol, 90°, 1 gal. Pack in percolator after thoroughly moistening; let stand one week, and percolate to 1 gal.

3.—Pure.—Vanilla bean, 1 oz.; pumice stone, 3 oz.; diluted alcohol, q. s. Cut the vanilla into small pieces, and beat in an iron mortar with the pumice until reduced to fine powder; moisten thoroughly with diluted alcohol, and allow to stand for three days in a warm place. Then transfer to a percolator, and add diluted alcohol until one pint of extract is obtained. The extract may also be made by maceration, of course. When so made add to the beans a pint of the menstruum, and when filtered off pass enough more through the filter to bring the finished preparation to the measure of one pint.

4.—Vanilla bean, ¾ oz.; tonka bean, ¼ oz.; pumice stone, 3 oz.; diluted alcohol, q. s. to make 1 pt. Proceed as in the foregoing formula.

5.—3.75 parts of Peruvian balsam and 1.75 parts of oil of orange are rubbed down with 250 parts of rectified alcohol and 10 parts of magnesia; 125 parts of essence of orris root, 62 parts of tonka beans, and 30 drops of tincture of castoreum mixed in. The whole is allowed to stand for four weeks in a warm place and it is then colored with caramel and filtered.

6.—Vanilla, in fine bits, 250 parts is put into 1,350 parts of mixture of 2,500 parts of 95 per cent. alcohol and 1,500 parts of distilled water. Cover tightly, put in the water-bath and digest for one hour at 140° F. Pour off the liquid and set aside. To the residue in the bath add one-half of the remaining water, treat in the same manner, and repeat. Now pack the vanilla in an extraction apparatus and treat with 250 parts of alcohol and water, mixed in the same proportions as before. Mix the results of three infusions first made, filter and wash the filter paper with the results of the percolation, allowing the filtered percolate to mingle with the filtrate of the mixed infusions.

7.—Vanilla.—Deodorized alcohol, 500 parts; proof spirits, 300 parts; sugar, 100 parts; vanilla, 100 parts. Slit the beans and cut them very fine; then mix them with the sugar, and bruise till moderately fine; add the alcohol and spirits, and macerate for two weeks, occasionally shaking; filter. Color with caramel.

8.—a.—Vanillin, 20 parts; absolute alcohol, 600 parts; water, 450 parts. Dissolve the vanillin in the alcohol and add the water.

b.—Musk, 1 part; potassium carbonate, 1 part; vanilla beans, 60 parts; boiling water, 240 parts; alcohol, 720 parts. Mix the vanilla, cut fine, the musk and potassium salt, and pour over them the boiling water. Let them stand until quite cold, then add the alcohol and set aside for 14 days. Finally strain, express and filter the percolate.

9.—Vanillin, 45 gr.; coumarin, 3 gr.; alcohol, 3 fl.oz.; glycerine, 2 fl.oz.; simple syrup, 2 fl.oz.; comp. tincture cudbear, 2 fl.dr.; water, enough to make 16 fl.oz. Dissolve the vanillin and coumarin in the alcohol, add the glycerine, syrup and tincture, and lastly enough water to make 16 fl.oz.

Wintergreen.—1.—Oil of wintergreen, 1 oz.; alcohol, 1 pt.; cudbear or cochineal, 10 gr.

2.—Wintergreen, 2 oz.; sassafras, 2 oz.; sarsaparilla, 4 oz.; burdock root, 4 oz.; dandelion, 1½ oz.; calamus, 4 dr.; dilute alcohol, 1 pt.; water, q. s. Grind all the drugs to a coarse powder and mix. Moisten the drugs with the dilute alcohol and macerate for two days and percolate with the dilute alcohol and water till 32 oz. of product are obtained, then add oil wintergreen, ½ dr.; oil sassafras, ½ dr., previously dissolved in 2 oz. of alcohol and then filter. Use 4 oz. of this extract to a gallon of simple syrup and color with caramel to suit.

Wormwood.—Deodorized alcohol, 500 parts; proof spirits, 400 parts; oil of wormwood, 50 parts; carbonate of magnesia, 50 parts.

SYRUPS

Preparation.

In the preparation of syrups, which are solutions of sugar, more or less strong according to the object for which they are used, care should be taken to employ only the best refined sugar, and either distilled or filtered rain water, as they will be rendered much less liable to spontaneous decomposition and become perfectly transparent without the trouble of clarifying. When, however, impure sugar is employed, clarification is always necessary. This is best done by dissolving the sugar in the water or fruit juices cold, and then beating up a little of the cold syrup with some white of egg and one or two ounces of cold water, until the mixture froths well. This must be added to the syrup in the boiler, and when the whole is frisked up to a good froth, heat should be applied and the scum which forms removed from time to time with a clean skimmer. As soon as the syrup begins to simmer it must be removed from the fire and allowed to stand until it has cooled a little, when it should again be skimmed, if necessary, and then passed through a clean flannel. By using refined sugar, however, all this trouble of clarification can be avoided.

When vegetable infusions or solutions enter into the compositions of syrups, they should be rendered perfectly transparent by filtration or clarification before being added to the sugar.

The proper quantity of sugar for syrups will, in general, be found to be two pounds avoirdupois to every pint of water or thin aqueous fluid. These proportions allow for the water that is lost by evaporation during the process and are those best calculated to produce syrup of proper consistency and possessing good keeping qualities. They closely correspond to those recommended by Guibourt for the production of a perfect syrup, which, he says, consists of 30 parts of sugar to 16 parts of water.

In the preparation of syrup it is of great importance to employ as little heat as possible, as a solution of sugar, even when kept at a temperature of boiling water, undergoes slow decomposition. The best plan is to pour the water (cold) over the sugar and to allow the two to lie together for a few hours in a covered vessel, occasionally stirring, and to apply a gentle heat, preferably that of steam or of a water bath, to finish the solution. Syrups are sufficiently boiled when some, taken up in a spoon, pours out like oil, or a drop cooled on the thumb nail gives a proper thread when touched. When a thin skin appears on blowing the syrup, it is judged to be completely saturated. These rude tests, however, often lead to errors, which might be easily prevented by employing the proper proportions or determining the specific gravity by immersing in the syrup one of Baume's saccharometers or syrup gauges, as indicated in the following table:

Sugar in 100 parts.	Sp. Gr.	Deg. Baume.
0	1.000	0
5	1.020	3
10	1.040	6
15	1.062	8
20	1.081	11
25	1.104	13.5
30	1.128	16.3
35	1.152	19
40	1.177	21.6
45	1.204	24.5
50	1.230	27
55	1.257	29.5
60	1.284	32
67	1.321	35

A fluid ounce of saturated syrup weighs 577½ grains; a gallon weighs 13¼ pounds; its specific gravity is 1.319 to 1.321, or 35° Baume; its boiling point is 220° F., and its density at the temperature of 212° is 1.260 to 1.261, or 30° Baume. The syrups prepared with the juices of fruits mark about two or three degrees more on Baume scale than the other syrups. According to Ure, the decimal part of the number denoting the specific gravity of a syrup multiplied by 26 gives very nearly the number of pounds of sugar it contains per gallon.

The preservation of syrups, as well as of all saccharine solutions, is best promoted by keeping them in a moderately cool, but not a very cold place. Let syrups be kept in vessels well closed and in a situation where the temperature never rises above 55° F. They are kept better in small than in large vessels, as the longer a bottle lasts the more frequently will it be opened and the syrup consequently exposed to the air. By bottling syrups while boiling hot, and immediately corking down and tying the bottles over with a bladder, perfectly airtight, they may be preserved even at a summer heat for years, without fermenting or losing their transparency.

The candying of syrups may be prevented (unless the syrup be over-saturated with sugar) by the addition of acetic or citric acid, two or three drams per gallon. Confectioners add a little cream of tartar to the syrup to prevent granulation. Syrup may be effectually prevented from fermenting by the addition of a little sulphite of potassa or lime; also by the use of salicylic acid in small quantities. Fermenting syrups may be immediately restored by exposing the vessel containing them to the temperature of boiling water. The addition of a little spirit is also good, say about 10 per cent.

A solution of sugar prepared by dissolving two parts of double refined sugar in one of water, and boiling this a little, affords a syrup which neither ferments nor crystallizes.

The best way to keep fruit syrups from fermenting is by bottling while hot into suitable bottles or larger vessels and to prevent access of air. This is the principle, and it may be carried out in various ways. For instance, fill the syrup while hot in quart bottles, previously warmed, and fill them almost full. Cover or cork the bottles temporarily until the syrup cools a little and contracts in volume; then, having heated a small quantity of the syrup, refill the bottles, cork them securely and wax them.

A great variety of syrups are made by the addition of proper flavoring ingredients to simple syrup, but in other cases, especially when the juices of fruits are employed, the syrup is not first prepared and then flavored, but the processes go hand in hand. In such instances specific instructions will be given. It is always advisable, when fresh fruit can be obtained, to use it in preference to the essence. One general recipe, which answers for nearly all fresh fruit, is as follows: Use nothing but the very best fresh fruit, which must be freed from stocks, etc., and crushed with a wooden instrument (not metal). When well mashed, let it stand in a room of even temperature (about 68° F.) for 4 days, which will give sufficient time for fermentation to take place; press out the juice from the fruit and let it settle in a cool cellar for 2 days, after which 5 pounds of the clear juice is to be simmered with 9 pounds of loaf sugar. While warm strain through flannel. The color may be improved by a solution of some coloring agent.

It is advisable to add to the fresh fruit, before setting it for fermentation, about 2 pounds of powdered loaf sugar for every 100 pounds of fruit. When cold, it is ready for bottling. Cleanliness should be strictly observed in all the utensils used. When bottling for storing, skim the top of any floating matter from the syrups in the large pan, and see that no residue at the bottom goes into the bottles. Most of the syrups not made of fruit may have a little mucilage of gum arabic added, in order to produce a rich froth. The following recipes comprise syrups made from the fruit and also from essences. These may be varied to suit taste and requirements. A variety of syrups have been brought into use by adding the various wines, such as claret, hock, sherry, etc., to simple syrup; others, by the addition of spirits, as milk punch, by adding to vanilla cream Jamaica rum and nutmeg. Almost any syrup may be made by the addition of a sufficient quantity of flavoring essence to simple syrup, but these artificially prepared syrups are inferior to those made from fresh fruits.

Red Coloring for Soda Water Syrups.—The most convenient is probably tincture of cudbear, as it affords a good, substantial and natural-looking color, miscible with syrups without cloudiness. It may be made as follows: 2 to 4 oz. powdered cudbear, 1 pt. diluted alcohol. Exhaust by maceration or displacement. Used alone, the tincture gives a shade of red closely imitating the color of raspberries or currants. For deeper red, like blackberries, the addition of some caramel is all that is necessary. The strawberry color is best imitated with tincture of cochineal. Aniline red, owing to its cheapness, is often used for coloring syrups, but it produces a glaring, artificial-looking bluish-red and is liable to the objection that it sometimes contains arsenic.

Comparative Cost of Syrups.

The following table shows the comparative cost of fourteen of the leading soda syrups both bought and made from various methods. In computing these figures, says the "Spatula," the average price of five of the leading makers of fruit juices, etc., has been taken, so as to give an accurate figure.

Kind of Syrup.	Price per gallon.				Price per 1½ ounces.			
	Made from extracts.	When bought ready for use.	Made from fruit stock, juice, etc.	Made from fruit.	Made from extracts.	When bought ready for use.	Made from fruit stock, juice, etc.	Made from fruit.
Orange	$0.42	$1.00	$0.78	$0.55	$0.005	$0.012	$0.0092	$0.0065
Lemon	.42	1.00	.78	.52	.005	.012	.0092	.0062
Raspberry	.42	1.00	.78		.005	.012	.0092	
Strawberry	.42	1.00	.78		.005	.012	.0092	
Pineapple	.42	1.00	.78		.005	.012	.0092	
Peach	.42	1.00	.78	From	.005	.012	.0092	From
Grape	.42	1.00	.72	best	.005	.012	.0086	best
Cherry	.42	1.00	.72	extract	.005	.012	.0092	extract
Vanilla	.43	1.00		.55	.0051	.012		.0065
Sarsaparilla	.42	1.00		.50	.005	.012		.006
Ginger ale	.52	1.00	From	.81	.0062	.012	From	.0096
Ginger	.40	1.00	coffee	.78	.0047	.012	coffee	.0092
Coffee	.40	1.00	.50		.0047	.012	.006	.006
Chocolate		1.00	Cheap	Best		.012	Cheap	Best
Chocolate from cocoa			.52	.61			.0062	.0072

Table Showing Amount of Syrup Obtained from:

1.—The addition of pounds of sugar to 1 gallon of water, and

2.—Amount of sugar in each gallon of syrup resulting therefrom:

Lbs. sugar added to 1 gal. cold water.	Syrup actually obtained Gals.	Pints.	Fl. ozs.	Lbs. of sugar in 1 gal. of syrup.
1	1	0	10	.93
2	1	1	4	1.73
3	1	1	14	2.43
4	1	2	8	3.05
5	1	3	2	3.6
6	1	3	12	4.09
7	1	4	6	4.52
8	1	5	0	4.92
9	1	5	10	5.28
10	1	6	4	5.62
11	1	6	14	5.92
12	1	7	8	9.18
13	2	0	2	6.38
14	2	0	12	6.7
15	2	1	6	6.91

Syrup Formulas.

Apple Syrup.—Proceed with apples as for pineapple syrups.

Apricots.—1.—Strain and rub 2 qt. of apricot pulp through a fine hair sieve into a bright and clean copper basin; add to this 2 gal. of simple syrup, boiling hot; mix well and add a little dissolved citric acid; stir occasionally until it becomes perfectly cold. When serving it add a little plain cream or ice cream to each glass of soda drawn.

2.—Apricot pulp (French), 1 pt.; solution of citric acid, 1 oz.; rock candy syrup, 3 pt.; orange flower water (best), 1 pt. Two ounces to 14-ounce glass; crushed ice and straws.

3.—Three qt. of simple syrup, 1 qt. of apricot juice, 2 oz. of soda foam, ½ oz. of citric acid solution. Color orange.

Banana.—1.—Oil of banana, 2 drams; tartaric acid, 1 dram; simple syrup, 6 pt.

2.—proceed with bananas as for pineapple syrups.

3.—Cut the fruit in slices and place them in a jar. Sprinkle with sugar and cover the jar, which is then enveloped in straw and placed in cold water and the latter is heated to the boiling point. The jar is then removed, allowed to cool and the juice is poured into bottles.

4.—Bananas, 2; simple syrup (10 lb. to gal.), 2 pt. Slice the bananas and bray them in a mortar until all lumps are reduced, and add the syrup in small quantities, mixing thoroughly after each addition. Care should be taken to employ ripe fruit and to peel it thoroughly. This syrup should be made fresh every day.

Blackberry.—1.—Prepared from ripe fruit the same as raspberry syrups. Blackberry syrup is improved by adding 1 oz. best French brandy to each quart.

2.—Prepare like either strawberry or mulberry syrup.

Calisaya Tonic.—Brown calisaya, 4 av.oz.; gentian, 1 av.oz.; orange peel, 1½ av.oz.; cinnamon, 1 av.oz.; alcohol, 65 per cent., enough to make 32 fl.oz. For use at the soda fountain mix one measure of this tincture with two measures of syrup.

Capillaire (Maidenhair) Syrup.—1.—Maidenhair, 8 oz.; boiling water, 5 pt.; orange flower water, 4 oz. Sugar, sufficient. Infuse the maidenhair in the boiling water. When nearly cold, press out and filter the liquid, add to it the orange flower water and dissolve it with sugar in the proportion of 7 oz. to each 4 fl.oz. of liquid.

2.—Nine lb. leaf sugar, 4 lb. orange flower water. Boil till the sugar is dissolved and the syrup is clear. While hot, strain through flannel, add to the cool syrup 2 drams of tartaric acid, previously dissolved in 8 oz. of the strongest orange flower water; lastly add 4 oz. of the best Rhine wine.

3.—Florida orange wine, 1 pt.; water, 1 pt.; granulated sugar, 6 lb. Dissolve by agitation or percolation and add liquid phosphate, 1 oz.

Celery.—Tincture celery seed, 2 oz.; juice of lemons, No. 2; pineapple juice, 16 oz.; syrup, enough to make 1 gal. A "gamey" flavor is obtained by bruising the fresh lemon peels in the syrup, afterward straining them out.

Cherry.—1.—Take sour cherries, a convenient quantity, bruise them in a porcelain, stone or wood mortar, to break the stones or pits of the fruit; express the juice, set it aside for three days to undergo fermentation, and proceed according to the directions given for strawberry syrup.

2.—Crush the cherries, pits and all, in a stone or wooden mortar. Express the juice, add about a pound of sugar for each pint of it, heat to the boiling point and strain. While the syrup is still hot, pour it into bottles which have been boiled and are of about the same temperature as the syrup and cork or plug the bottle's mouth with antiseptic cotton. When wanted for use, dilute with plain syrup and add about an ounce of a saturated solution of citric acid to each gallon of the diluted syrup.

3.—It is best to use as far as possible the black varieties, which are of fine flavor and good color. Stone the cherries, pound about one-tenth of the stones to a paste, mash and mix well together, let stand for a short time, stirring it occasionally, and strain.

4.—Essence of cherries, 4 oz.; citric acid, 3½ oz.; cane sugar, 6 lb.; distilled water, 10 pt.; liquid cochineal, sufficient, Dissolve the sugar in the water, and, when cold, add the other ingredients.

5.—Stem and wash 1 qt. of cherries. Stone the cherries and pass through the chopper and add syrup to make 2 qt. Cleanliness should be observed in all the processes. Utensils and machine should be washed before the next fruit is prepared, and when the work is finished all utensils and machines should be carefully washed and dried.

6.—Cherry Phosphate Syrup.—Cherry juice, 3 pt.; sugar, 6 lb.; water, 1 pt.; acid phosphate, 4 oz. Bring to boil and when cool add acid phosphate.

7.—Wild Cherry Syrup.—a.—Ground wild cherry, 2 lb.; water, 1 gal. Infuse for 24 hours, express and add sugar, 9 lb.

b.—Wild cherry bark (in coarse powder), 5 oz. Moisten the bark with water and let it stand for 24 hours in a close vessel. Then pack it firmly in a percolator and pour water upon it until 1 pt. of water is obtained. To this add sugar, 28 oz.

8.—Wild Cherry Phosphate Syrup.—Syrup of wild cherry, U. S. P., 10 fl.oz.; cherry juice, German, black, 8 fl.oz.; glucose syrup, 12 fl.oz.; diluted phosphoric acid, 2 fl.oz.; oil bitter almond, 4 drops. Mix.

Chocolate.—1.—Best chocolate, 8 oz.; water, 2 pt.; white sugar, 4 lb. Mix the chocolate in water and stir thoroughly over a slow fire. Strain and add the sugar.

2.—Bark of roasted cacao bean, 2 oz. Reduce to a moderately fine powder, mix with simple syrup, 2 oz. Pack in a percolator and exhaust with the following menstruum at a boiling temperature; Sugar, 12 oz.; water, 8 oz., so as to obtain 1 pt. of syrup. To the percolate add, when cold, extract of vanilla, 2 fl.dr.

3.—Cocoa, soluble, 2 oz.; water, 32 fl.oz.; sugar, 52 oz.; vanilla extract, about 4 fl.dr. Triturate the cocoa in a mortar with a portion of the water to a smooth paste, add the remainder of the water, then the sugar, heat the whole in a suitable vessel with constant stirring, until it nearly reaches the boiling point, then strain through a fine sieve, and when cold add the vanilla extract.

4.—Chocolate, powder, 4 oz.; sugar, 52 oz.; vanilla extract, about 6 fl.dr.; water, boiling, 24 fl.oz. Mix the chocolate and sugar, triturate the mixed powders with the boiling water added slowly and strain. When cool, add the vanilla extract.

5.—Blank's chocolate, 8 oz.; powdered borax, ½ oz.; powdered boric acid, ½ oz.; starch, 1 oz.; water, 64 fl.oz.; sugar, 6 lb.; vanilla extract, about 1 fl.oz. Grate the chocolate, triturate with the borax, boric acid and starch, add slowly, with stirring, the water, bring to a boil, strain, allow to cool and add the extract. In view of the popular outcry against the use of boric acid, this formula is open to objection.

6.—Chocolate, 4 oz.; granulated sugar, 24 oz.; water, 48 fl.oz. Put the chocolate in an enameled pot and add about 8 avoirdupois ounces of sugar, stirring well with a porcelain pestle until all the lumps in the chocolate are reduced to powder and are well mixed with the sugar. Add the remainder of the sugar, mixing well. Heat the water to boiling, pour it on the mixture of chocolate and sugar, stir well with a wooden ladle and boil the whole for a few minutes.

7.—Cocoa, 8 oz.; hot water, 2 pt.; gelatine, Gooper's, ½ sheet; sugar, 1 lb. Boil together for a few minutes and then strain.

8.—Cocoa, light, soluble, 4 oz.; granulated sugar, 2 lb.; boiling hot water, 1 qt.; extract vanilla, 1 oz. Dissolve the cocoa in hot water by stirring, then add the sugar and dissolve. Strain and when cold add the vanilla extract.

9.—Blank's chocolate, plain, 4 oz.; boiling water, 4 oz.; water, 28 oz.; sugar, 50 oz.; extract of vanilla, ½ oz. Cut the chocolate into small pieces, then add the boiling water and stir briskly until the mixture forms into a thick paste and assumes a smooth and uniform appearance. Then slowly add the remainder of the water, stirring at the same time, and set aside until cold. Then remove carefully by skimming the layer of solid fat which consists of almost pure cacao butter; add the sugar, dissolve it by the aid of a gentle heat and allow the whole to come to a boil. Then strain and add the extract of vanilla.

10.—Confectioners' chocolate, ½ lb.; hot water, 2 qt.; condensed milk, 1 can; granulated sugar, 5 lb.; extract of vanilla, 1 oz.; gum foam, 1 oz.; whites of 2 eggs. Cut the chocolate fine, place in an evaporating dish and rub with the water (which must be boiling hot), gradually added, until a smooth paste is obtained; then stir in the milk and sugar, and when the latter is dissolved set aside to cool. When cold, skim off any particles of grease, etc., which may have arisen to the top, add the white of egg previously well beaten, the extract of vanilla and the gum foam. Strain through muslin and it is ready for use.

11.—Fruit Chocolate. — Strawberry syrup, 10 fl.oz.; vanilla syrup, 10 fl. oz.; raspberry syrup, 8 fl.oz.; chocolate syrup, 4 fl.oz. In serving draw 2 fluid ounces of this syrup into a 12-ounce glass, add 1 or 2 fluid ounces of cream, nearly fill the glass with the coarse stream of carbonated water and then top off with the fine stream.

Cinchona Syrup.—1.—Tincture cinchona, detannated (N.F.), 3 fl.oz.; tincture vanilla, 1 fl.oz.; essence orange, 2 fl.dr.; alcohol, 3 fl.oz.; water, 6 fl.oz.; syrup, 6 fl.oz.; red coloring, enough; syrup lemon, enough to make 32 fl.oz. Mix the first five ingredients, filter through a small amount of purified talc and color red to suit. Serve "solid."

2.—Tincture of detannated cinchona, 6 oz.; extract of vanilla, 2 oz.; alcohol, 6 oz.; rock candy syrup, 8 oz.; spirits of curacoa, 2 dr.; distilled water, enough to make 1 qt. Mix and filter through carbonate of magnesia and then color a deep red with carmine solution. Then add 1 quart of lemon syrup and shake. Pour 1 ounce of cinisaya syrup into a mineral glass and draw crbonated water in another glass. Mix thoroughly by pouring from one glass to the other and serve.

Cinnamon.—Oil of cinnamon, 30 m.; carbonate of magnesia, 60 gr.; water, 2 pt.; granulated sugar, 56 oz. Rub the oil first with the carbonate of magnesia, then with the water gradually added, and filter through paper. In the filtrate dissolve the sugar without heat.

Coca.—1.—Wine coca, 1 pt.; cane sugar or rock candy syrup, 7 pt. This has a pleasant, very slightly bitterish taste.

2.—*Pepsin.*—Crystal pepsin, 20 gr.; elixir of coca, 2 oz.; syrupy phosphoric acid, ½ dr.; chocolate syrup, 14 oz. Mix. Trim with grated cocoanut.

3.—*Vanilla.*—Wine of cocoa, 1 pt.; strong extract of vanilla, 2 oz.; cane sugar or rock candy syrup, 7 pt.

Coca-Kola.—1.—Fld. ext. kola, 4 dr.; wine of coca, 2 oz.; syrup, enough to make 32 oz. Serve 1 ounce "solid" in an 8-ounce glass of carbonated water.

2.—Fld. ext. kola, 1 oz.; elixir coca, 2 oz.; or wine of coca, 4 oz.; extract vanilla, 2 dr.; essence rose, 2 dr.; essence cinnamon, 2 dr.; syrup, enough to make 32 oz. Serve as above.

3.—Wine coca, 4 oz.; wine kola, 8 oz.; raspberry juice, 4 oz.; blackberry brandy, 1 oz.; lime juice, 1 oz.; syrup, 8 oz. Serve as above.

4.—Fluid extract coca, 1 fl.dr.; fluid extract kola, 1 fl.oz.; simple elixir, 8 fl.oz.; syrup, sufficient to make 16 fl.oz. Mix the fluid extract with the elixir, filter through paper and add to the simple syrup.

5.—Mint.—Wine koka, 6 oz.; wine cola, 6 oz.; orange syrup, 2 pt.; raspberry syrup, 1 pt. M.: Serve 2 oz. to glass, adding dash of essence peppermint, solid.

6.—Wine.—Kola wine is made by extracting 1 oz. of fresh kola nut with 16 oz. of sherry wine. Coca wine is made by extracting 1 oz. of coca leaves with 10 oz. of sherry wine.

Coffee.—1.—Coffee syrup, 2 pt.; cream, 1 pt.

2.—Coffee, roasted, ½ lb.; boiling water, 1 gal. Enough is filtered to make ½ gal. of the infusion to which add granulated sugar, 7 lb.

3.—Ground Java coffee, 2 oz.; simple syrup, 2 fl.oz. Mix and pack in a percolator and add, boiling hot, a mixture of loaf sugar, 12 av.oz.; distilled water, 8 fl.oz. To percolate 1 pt. of syrup.

4.—Take of ground, roasted coffee, 4 oz.; boiling water, 2 pt.; sugar (com.), 4 lb. Infuse the coffee in the water until cold, strain, add the sugar and make a syrup.

5.—Take 1 lb. of fresh roasted Java or Mocha coffee and percolate according to the directions of the Pharmacopoeia with the following mixture: Alcohol, 8 oz.; glycerine, 4 oz.; water, 4 oz., and continue the percolation with diluted alcohol until 14 ounces have passed. Set this aside and continue the percolation until the coffee is exhausted. Evaporate to 2 ounces and mix with the 14 ounces reserved. This makes a fluid extract of which 1 ounce is sufficient for 1 pint of syrup.

6.—Java coffee, 1 oz.; Mocha coffee, 1 oz.; Rio coffee, 4 oz.; glycerine, 1 fl.oz.; simple syrup, extra heavy, 4½ pt.; hot water, a sufficient quantity. Roast the coffee, reduce at once to fine powder, moisten with about 7 ounces of hot water with which the glycerine has been mixed. Let stand for 1½ hours in a very warm place and then percolate until 24 fluid ounces of liquid are obtained. Add to this the syrup.

Crab Apple Tonic.—Sweet cider, 1 gal.; sugar, 7 lb.; extract malt, 4 fl.oz.; solution citric acid, 1½ fl.oz. Evaporate the cider to 4 pints. In this dissolve the sugar, strain and add the remaining ingredients. Serve either "solid" or with foam This syrup is said to yield a drink quite similar to some proprietary syrups, such as *champagne mist* and *kylo.*

Cream.—1.—Fresh cream, ½ pt.; fresh milk, ½ pt.; powdered sugar, 1 lb. Mix by shaking and keep in a cool place. The addition of a few grains of bicarbonate of soda will for some time retard souring.

2.—Oil of sweet almonds, 2 oz.; powdered gum arabic, 2 oz.; water, 4 oz. Make an emulsion and add simple syrup enough to complete 2 pt.

3.—One pt. condensed milk, 1 pt. water, 1¼ lb. sugar. Heat to boiling and strain. This will keep for over a week in a cool place.

4.—Imitation.—Make an emulsion with 3 oz. fresh oil of sweet almonds, 2 oz. powdered gum arabic and 2 oz. water: then dissolve 1 lb. white sugar by gentle heat, strain, and when cool add the whites of 2 eggs. It should be put up in small bottles, well corked, in a cool place. This is not only an excellent imitation and substitute for cream syrup, but will keep for a considerable time.

Currant.—1.—Refined sugar, 5 kilos:

conserve of currants, 2.6 liters. Put the sugar in a pan, add the conserve and heat rapidly. Remove the syrup from the fire as soon as it boils. Skim and pass through woolen cloth.

2.—Six pt. simple syrup, 2 pt. water, 2 oz. tartaric acid, 3 dr. fruit essence. Mix, color with red carmine for red currants and with burnt sugar for black.

3.—One pt. red currant juice, 1 gal. simple syrup.

4.—Proceed as for strawberry syrup.

5.—Framboise Current Syrup.—Raspberry syrup, 1 pt.; currant syrup, 4 pt.

6.—French Currant Syrup.—French currant juice, 1 bottle; citric acid, 2 dr.; caramel, 1 dr.; tincture of cochineal, 3 dr.; syrup, enough to make 2 gal. M.

Fancy Syrup.—Vanilla syrup, 2 pt.; pineapple syrup, 8 oz.; raspberry syrup, 8 oz.

Foam.—1.—If it is thought desirable to give an extra foam or "head" this formula will do: Take soap bark in coarse powder, 2 oz.; animal charcoal, 1 oz. Macerate 2 days in alcohol, 2 oz.; glycerine, 2 oz.; distilled water, 4 oz. Percolate to obtain 8 oz. of finished product. Quantity to be used, 2 drams to the gallon of concentrated ginger ale.

2.—To each gallon of syrup add from 2 to 4 oz. of gum arabic dissolved in its own weight of water.

3.—Quillaya bark, 4 oz.; alcohol, 4 oz.; glycerine, 4 oz.; water, 8 oz. Exhaust by percolation so as to make one pint of tincture. From 2 to 5 drams of this tincture to every gallon of syrup will be found sufficient to give every glass of soda drawn that creamy appearance so universally liked. At the same time it has the advantage of being cheap, is used in such minute quantities that it cannot be discovered by taste, is always ready for use and will never spoil.

4.—Irish Moss.—Take of Irish moss 1 oz. and water enough to make 1 pt. Wash the Irish moss in water, to free from impurities; add 1 pt. of water and boil for 5 minutes, or heat in a water bath for 15 minutes, or macerate in cold water for 24 hours, with occasional stirring; filter through purified cotton, on a muslin strainer, in a hot water funnel. This mucilage, it is claimed, has no more taste than mucilage of gum arabic and is said to keep better. It can be used with soda syrup in the proportion of from 2 to 4 oz. to 1 gal. of the syrup.

Fruit Juices, Preservation of.—Express the juice of any fruit; filter and pour into champagne bottles; fill them up to the bend of the necks; cork tightly and fasten the corks down with cord or wire; then put the bottles into a kettle; set them on a double sheet of coarse paper, placed on the bottom of the kettle, and pack the bottles loosely in with hay or cloths; then fill the kettle up to the necks of the bottles with cold water; place over a moderate fire and let boil for 20 minutes, then remove the kettle from the fire, allowing the bottles to remain in the kettle until the water becomes cold; then seal the corks and pack the bottles sideways in a cool, dry cellar. Prepared in this way, they will keep in a perfect state for a very long time. Fruit pulps are preserved in precisely the same way, except that they have about an ounce of finely powdered sugar added for each bottle of pulp so put up.

De Brevans, in "Manufacture of Liquors and Preserves," gives the following formulas:

Huckleberries, Barberries, Cherries and Grapes.—Crush the fruit and pass the pulp through a horsehair sieve; crush the marc and unite and carry to the cellar. After 24 hours of fermentation filter and preserve. The juice of cherries is better when a mixture of black and red cherries is used.

Orange and Lemon Juice.—Remove skin and seeds, crush the pulp and press and mix with rye straw washed and cut fine to assist the separation of the juice. Clarify by repose, filter and preserve.

Quince, Pear and Apple Juice.—Peel and rasp the fruit, taking care not to touch the seeds. Press the pulp, mixed with rye straw, washed and cut fine. Clarify by repose, filter and preserve. The quinces should be fully ripe.

Raspberry Juice.—Crush the fruit and press the marc. The liquid is allowed to repose for 1 or 2 days, after which it is filtered. One-fifth of the weight of red cherries is sometimes added to the raspberries. Another process reported to have given excellent results is this one: The clarified juice is heated to boiling in a copper vessel and then poured into a dish. Meanwhile the bottles are provided with stoppers and are then gradually filled, a space of about 2 centimeters in the neck being left empty; some alcohol is then poured upon the hot liquid and the bottle is quickly stoppered, the cork being further secured as the liquid cools. The alcohol which evaporates into the empty space is sufficient for the preservation of the juice. The juice of fresh herbs may be preserved in the same manner. This process seems to be an entirely unobjectionable one. It is generally believed that many of the fruit juices as found in the market are usually preserved by means of antiseptics and anti-ferments, such as salicylic acid, boric acid, boroglyceride, sodium sulphite, peroxide of hydrogen, formaldehyde, etc.

Fruit Punch.—Strawberry syrup, 10 oz.; orange syrup, 10 oz.; pineapple syrup, 10 oz.; lemon juice, 2 oz. Mix. Use 2 ounces of this syrup to a large glass one-third full of shaved ice, then fill with carbonated water and add a slice of pineapple and some strawberries.

Ginger.—1.—Soluble essence of ginger (N.F.), 3 oz.; tincture of ginger, 1 oz.; syrup, 6 pt.; water, 2 pt.

2.—Take of tincture of ginger, 2 oz.; white sugar, 7 lb. (com.); water, ½ gal. Heat the sugar and water until the sugar is dissolved, raise to the boiling point, then gradually add the tincture of ginger, stirring briskly after each addition.

3.—Six pt. simple syrup, 2 pt. water, 1 oz. tartaric acid, 2 oz. ginger. Burnt sugar to color.

4.—Four oz. extract of Jamaica ginger, 1 gal. syrup. Shake well. A few drops of tincture curcuma to color.

5.—Nine lb. loaf sugar, 5 lb. water, 12 oz. essence ginger, 4 oz. Rhine wine. Boil sugar and water until dissolved and clear. When cool add ginger and wine. Mix well and let settle.

6.—Tincture of ginger, 2 fl.oz.; simple syrup, 4 pt.

7.—Soluble extract of ginger, 2 oz.; tincture of capsicum, 4 dr.; simple syrup, 1 gal. Mix. For a good many people ginger is scarcely warm enough without the addition of Cayenne pepper.

8.—Syrup of ginger, 2 pt.; syrup of lemon, 1 pt.; tincture of capsicum, 1 dr.

Grape.—1.—Brandy, ½ pt.; tincture of lemon, 1 oz.; simple syrup, 1 gal.; tincture red saunders, 1 qt.

2.—Brandy, ½ pt.; spirits of lemon, ¼ oz.; tincture of red saunders, 2 oz.; simple syrup, 1 gal.

3.—A grape syrup, not an artificial syrup, or one for fountain use, but a syrup from the fruit, for domestic or table use, etc. Take 20 lb. ripe freshly picked and selected tame grapes, put them into a stone jar and pour over them 6 qt. of boiling soft water. When sufficiently cool to allow it, well squeeze them thoroughly with the hand, after which allow them to stand 3 days on the furnace with a cloth thrown over the jar, then squeeze out the juice and add 10 lb. of crushed sugar; let it remain a week longer in the jar; then take off the scum, strain and bottle, leaving a vent until done fermenting, when strain again and bottle tight and lay the bottles on the side in a cool place.

4.—Brandy, ½ pt.; extract of lemon, ½ oz.; tincture of cudbear, 1 oz.; simple syrup, 1 gal.

5.—Bottle grape juice, 1 qt.; sugar, 1 lb.; simple syrup, 2 qt.; sol. citric acid, 1 oz. Dissolve the sugar in the grape juice and add the acid and syrup.

6.—Grape juice, 2 pt.; acid solution, 1 oz.; gum foam, 1 oz.; simple syrup, q. s. 1 gal. Mix thoroughly. To serve a grape phosphate use 1 oz. of the syrup to an 8-oz. mineral glass.

Grenadine.—Extract grenadine, 2 oz.; liquid foam, 1 oz.; red fruit coloring, 1 dr.; syrup, 1 gal. Mix, then add fruit acid, 2 oz.

Hock and Claret.—Hock or claret wine, 1 pt.; simple syrup, 2 pt.

Imperial.—Equal parts of raspberry and orange syrups.

Iron, Malt and Phosphate.—Solution of phosphate of iron (1 to 8), 2 fl.dr.; extract of malt, 1 fl.oz.; solution of acid phosphate, 1 fl.oz.; solution of albumen, 2 fl.oz.; solution of caramel, 2 fl.dr.; extract of vanilla, 1 fl.dr.; extract of bitter almonds, ½ fl.dr.; syrup, sufficient to make 20 fl.oz. Mix well.

Java Tonic.—Compound tincture of cinchona, 6 fl.dr.; coffee syrup, 8 fl.oz.; vanilla syrup, 4 fl.oz.; glucose syrup, 8 fl.oz.; syrup, enough to make 32 fl.oz. Serve "solid" in 8-ounce glasses, like the phosphates.

Kola.—1.—Fluid extract of kola (from fresh nuts), 2 fl.dr.; claret wine, 12 fl.oz.; raspberry juice, 1½ fl.oz.; solution of acid phosphate, 4 fl.oz.; solution of citric acid, 2 fl.oz.; soda syrup, to make ½ gal.; solution of carmine, to color deep red. Serve "solid" in 8-ounce glasses, using about 1 ounce of this syrup and filling the glass with the coarse stream of carbonated water.

2.—Kola cordial, ½ oz.; calisaya cordial, 1 oz.; catawba wine, 1 oz.; frothing mixture, ¼ oz.; blackberry syrup, 14 oz. Mix. Trim with fresh berry.

3.—Champagne.—a.—Grape jelly, 1 lb.; tartaric acid, 1 dr. Dissovle both in a little hot water and add fluid extract of kola, 5 dr.; extract of vanilla, 3 dr.; acetic ether, 5 drops; pelargonic ether, 5 drops; rock candy syrup, 1 gal. Serve without foam.

b.—Stock champagne syrup, 7 pt.; kola wine, 1 pt.; fruit acid, 3 oz. sarsaparilla color, ½ oz.; Tufts' extract vanilla, 1½ oz.

4.—Cherry-Kola.—Serve same as Cold

conserve of currants, 2.6 liters. Put the sugar in a pan, add the conserve and heat rapidly. Remove the syrup from the fire as soon as it boils. Skim and pass through woolen cloth.

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5.—Bottle grape juice, 1 qt.; sugar, 1 lb.; simple syrup, 2 qt.; sol. citric acid, 1 oz. Dissolve the sugar in the grape juice and add the acid and syrup.

6.—Grape juice, 2 pt.; acid solution, 1 oz.; gum foam, 1 oz.; simple syrup, q. s. 1 gal. Mix thoroughly. To serve a grape phosphate use 1 oz. of the syrup to an 8-oz. mineral glass.

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b.—Stock champagne syrup, 7 pt.; kola wine, 1 pt.; fruit acid, 3 oz. sarsaparilla color, ½ oz.; Tufts' extract vanilla, 1½ oz.

4.—Cherry-Kola.—Serve same as Cold

Coca. To make 1 gal. Cherry-Kola: Kola wine, 6 oz.; raspberry syrup, 12 oz.; citric acid (sol.), ½ oz.; plain syrup, quantity sufficient to make 1 gal.

5.—Fruit.—Fl. ext. kola, 2 dr., grape juice, 10 oz.; pineapple juice, 6 oz.; lemon syrup, q. s. 2 pt. M.

6.—Mint Phosphate.—Kola cordial, 1 oz.; syrupy phosphoric acid, ½ dr.; spearmint cordial, 3 dr.; lemon syrup, 15 oz. Mix. Trim with sprigs of fresh mint.

7.—Pepsin.—Crystal pepsin, 15 gr.; kola cordial, 1 oz.; syrupy phosphoric acid, ½ dr.; red currant syrup, 15 oz. Mix. Trim with sliced lemon.

Lemon.—1.—Dissolve 6 dr. of tartaric acid and 1 oz. of gum arabic, in pieces, in 1 gal. of simple syrup; then flavor with 1½ fl.dr. of best oil of lemon, or flavor with the saturated tincture of the peel in cologne spirits.

2.—Grate off the yellow rinds of lemons and beat it up with a sufficient quantity of granulated sugar; express the lemon juice; add to each pt. of juice 1 pt. of water, 3½ lb. granulated sugar, including that rubbed up with the rind; warm until the sugar is dissolved and strain. Under no circumstances must the syrup be allowed to boil, and the less heat that can be used to effect the complete solution of the sugar the better will be the syrup.

3.—Add to 1 gal. simple syrup, when cold, 20 drops fresh oil lemon and ½ oz. citric acid, previously dissolved in 3 oz. water; mix by shaking well in a bottle; add 4 oz. gum solution, made by dissolving 2 oz. of fine white gum arabic in 2 oz. warm water.

4.—Simple syrup, 6 pt.; distilled water, 2 pt.; essence lemon, 2 oz.; citric acid, 2 oz., dissolved in boiling water. Mix and, if required, color with saffron.

5.—Simple syrup, 1 gal.; oil of lemon, 25 drops; citric acid, 10 dr. Rub the oil of lemon with the acid, add a small portion of syrup and mix.

6.—Lemons, 8; alcohol, 4 oz.; citric-acid solution, 50 per cent., 2 oz.; sugar, 150 oz.; water, 10 pt. Peel the lemons, chop the peeling fine and exhaust with the alcohol. Press out the juice of the lemons and add it to the alcoholic extract. Make a syrup of the sugar and water, by the aid of a mild heat, let cool and add the citric-acid solution. Beat up the white of 8 eggs to a stiff foam, stir it into the syrup and apply a slow heat, just sufficient to coagulate the albumen. Now strain and finally add the alcoholic extract and lemon juice.

Licorice Syrup.—To 45 parts water add 7½ parts licorice root, cut in pieces. Boil for 15 minutes. Pour the liquid off and evaporate to 26 parts. Add 30 parts white sugar and 30 parts purified honey. Boil up once.

Malted Milk.—Malted milk, 8 oz.; hot water, 8 oz.; simple syrup, 4 pt.

Maple.—1.—Maple syrup, 4 lb.; water, 2 pt.

2.—Maple sugar, 3½ lb.; water, 1 qt. Dissolve, and, if desired, add a small proportion of gum solution to produce a rich froth.

3.—Maple sugar, 3½ lb.; water, 1 qt.; solution of citric acid, ½ oz.; extract of vanilla, 1 dr.; soda foam, ½ oz. Dissolve the sugar in the water by the aid of a gentle heat; strain and add the solution of acid, extract and foam. The extract may be omitted if desired.

4.—Maple sugar, 3 lb.; water, 30 oz.; solution of citric acid, 4 dr.; vanilla extract, 1 dr.; soda foam, sufficient.

5.—Maple sugar syrup, 7 pt.; fine old sherry wine, 13 oz.; soluble ess. vanilla, 2 oz.; lactic acid, 1 oz. Mix well together and filter. For dispensing, put into a 12-oz. tumbler 2 oz. of this syrup, add 1 fresh egg and fill up with iced cold rich milk. Shake thoroughly and dress with whipped cream.

6.—Artificial.—a.—This is said to be given to simple syrup or glucose by the addition of aqueous extract of guaiac wood. The wood, finely rasped, is boiled down to the condition of an extract. This is shaken up with ether, or a mixture of alcohol and ether, to get rid of the resinous matters taken up in boiling. Some manufacturers attain the desired end, though not so completely, by adding cold water to the aqueous extract while still hot, which causes the resinous matter to precipitate. After standing a little the clear extractive is poured off and is ready for use. It is said that when a proper mixture of cane syrup and glucose is used the imitation of the maple flavor is so near as to puzzle an expert.

b.—Make a solution of white sugar, two in one; bring to a boil and remove from the fire; then add to it strips of the inner bark of hickory (carya alba) or white heart hickory (carya tomentosa), ½ oz. to each pint of syrup; let stand 10 minutes and strain.

c.—Red corn cobs, 4; water, 2 pt.; enough light brown sugar. Boil the cobs in the water until the latter is quite red, strain and add sufficient sugar to make a heavy syrup. When cold the flavor is very pleasant to the taste.

Marshmallow Syrup. — 1. — Orange

flower water, 4 oz.; gum arabic, 12 dr.; extract vanilla, ½ oz.; syrup simp., 8 pt.

2.—Rock candy syrup (Barker's), 7 pt.; powdered gum acacia, 10 dr.; orange flower water, 4 pt.; citric acid, 4 dr.; water, enough to make 1 gal.

3.—Althea root, cut, 20 grams; sugar, 480 grams; distilled water, q. s. 1,000 grams. The althea, previously washed with cold water, is macerated for 2 hours in 400 grams cold distilled water. In the strained liquid 480 grains of sugar is dissolved and then sufficient water added to make 1,000 grams of syrup.

Mint.—1.—Make syrup of 1½ oz. peppermint essence, 4 dr. vanilla extract, 1 oz. solution citric acid, ½ gal. syrup, sufficient water and soda foam and enough tincture of grass to impart a green tint. Mix essence with 2 ounces of water and filter through powdered magnesium carbonate, passing enough water through to make 2 ounces filtrate. Add the remaining ingredients. Serve solid in 8-ounce glass.

2.—Spirits of peppermint, 1 oz.; soda foam, 1 oz.; simple syrup, 1 gal.

3.—Peppermint water (fresh), 4 pt.; sugar, 6 lb.; enough vegetable green color.

Nectar.—1.—Take of vanilla syrup, 5 pt.; pineapple syrup, 1 pt.; strawberry, raspberry or lemon syrup, 2 pt. Mix.

2.—Extract vanilla, 1 oz.; extract rose, 1 oz.; extract lemon, 1 oz.; extract bitter almonds, 1 oz. Mix and add 1 gal. simple syrup; color pink with cochineal.

3.—Mix 3 parts vanilla syrup with 1 part each of pineapple and lemon syrups.

4.—Vanilla syrup, 3 parts; pineapple syrup, 1 part; cream syrup, 1 part. The cream syrup is made by dissolving in the cold 3 parts of sugar in 2 of rich milk, fortified with some additional cream.

Nuts.—Blanch 1 lb. of the kernels of hickory, or walnuts, in the usual way, then powder in a Wedgwood or porcelain mortar, a few at a time, adding a few drops of lemon juice to prevent the separation of the oil, and sufficient water, gradually, to make a pasty emulsion. As each batch of kernels is emulsified, says a German publication, empty the contents of the mortar on a linen cloth, and by gathering the corners and twisting, squeeze out all that will pass into a proper receptacle. The residue on the cloth, after squeezing, is to be returned to the mortar, to be again treated, along with the next batch. Proceed in this manner until the kernels have all been exhausted. The accumulated emulsion is to be passed through a strainer, and the colate, which should make about 2 pt., is to be added to and thoroughly incorporated with 3 qt. of cream syrup. This formula may be varied and perhaps improved upon by the addition of vanilla extract or other flavoring extracts. Other nuts may be used, notably the pecan and filbert, the former making an especially rich emulsion.

Nut Fruit Syrup.—Roasted almonds, 1 lb.; whole cherries, 8 oz. Grind of chop quite fine, then add simple syrup, 1 qt. Boil for 10 minutes. When cold add simple syrup, to make 1 gal.; almond extract, 5 drops; rose extract, 3 drops. Mix and stir thoroughly.

Orange.—1.—Oil of orange, 30 drops; citric acid, 4 dr.; simple syrup, 1 gal. Rub the oil with the acid and mix. Instead of the essential oil, a tincture of the fresh peel of Florida orange can be used with advantage.

2.—Sicilian oranges, a convenient quantity. Express the juice; to each pint of it add ½ pt. of water, filter or strain, and in the liquid dissolve 38 oz. of sugar. Flavor with some of the fresh peel crushed with the sugar, or still better, with Florida orange peel.

3.—Take 6 select oranges, grate off the yellow part only into a good-sized mortar. Add ½ lb. of sugar, rub thoroughly with a pestle and let stand for 2 or 3 hours. Extract the juice from the oranges and add. Stir until all the sugar is dissolved, adding a little water if necessary, and strain through cheese cloth into a gallon bottle. Add syrup to make 1 gallon and mix thoroughly. No artificial coloring, fruit acid or foam is necessary.

4.—Fresh oil of orange, ½ dr.; citric acid, 1 oz.; water, 2 oz.; simple syrup, 1 gal.; tincture of curcuma, a sufficient quantity. Rub the oil and acid crystals in a mortar until the latter have been reduced to a fine powder, add the water, and, when the acid has been dissolved, the syrup. A few drops of tincture of curcuma will give a good color.

5.—Blood Orange.—Orange juice, 1 pt.; raspberry juice, 1 oz.; claret wine, ½ oz.; fruit acid, ½ oz.; foam extract, 1 oz.; cochineal color, ½ dr.; simple syrup, 1 gal. The kind of fruit acid used in this formula consists of 2 oz. of citric acid dissolved in 4 oz. of water; the cochineal color is 2½ oz. of cochineal in 20 oz. of water, macerated for several days and filtered.

6.—Orange Flower Syrup.—Orange flower water, 1 pt.; granulated sugar, 28 oz. Dissolve without heat.

7.—Orange Peel.—Fresh orange peel, 2 oz.; alcohol, 2 oz.; aqua pura, q. s. to percolate 9 oz.; sugar, 14 oz. Cut the peel in small pieces, put in mortar and add the alcohol. Thoroughly bruise to a pulp, put in a glass percolator, add the aqua pura until 9 oz. have percolated. Put the sugar in percolator and percolate the menstruum through the sugar until dissolved.

8.—Orange Phosphate. — Dispensers who use a large quantity of orange phosphate will find it convenient to previously prepare a special syrup for the purpose. To 1 gal. of fruity orange syrup add about 6 oz. of solution of acid phosphate. The syrup so made is ready for use and dispensing with it is much more rapid than using a squirt bottle.

Orgeat Syrup.—1.—Cream syrup, ½ pt.; simple syrup, ½ pt.; vanilla syrup, 1 pt.; oil bitter almonds, 5 drops.

2—Beat to an emulsion in a mortar 8 oz. blanched sweet almonds and 4 oz. bitter ones, adding a little water; when smooth add 3 pt. water; mix and strain. Dissolve in this without heat 6 lb. sifted white sugar and 4 oz. fresh orange flower water. An excellent imitation of orgeat syrup is made by flavoring cream syrup, made with eggs and milk, with a few drops of oil of bitter almonds.

3.—Sweet almonds, 8 oz.; bitter almonds, 2½ oz.; sugar, 3 lb.; water, 26 oz.; orange flower water, 4 oz. Blanch the almonds, rub them in a mortar to a fine paste with 12 oz. of the sugar and 2 oz. of the water. Mix the paste with the remainder of the water, strain with strong expression, add the remainder of the sugar and dissolve it with the aid of a gentle heat. Lastly, add the orange flower water and strain the syrup again.

4.—Cream syrup, ½ pt.; vanilla syrup, 1 pt.; simple syrup, ½ pt.; oil bitter almonds, 5 drops.

Pear Syrup.—Proceed with it same as pineapple syrups.

Peach Syrup.—Proceed in the same manner as for strawberry syrup.

Pepso-Curacoa.—Blood orange syrup, 5 pt.; pineapple fruit syrup, 1 pt.; pepsin wine, 1 pt.; Dutch curacoa, 14 oz.; citrophosfol, 2 oz. Mix and filter. For dispensing, draw 2 oz. of this syrup to glass and fill up with cold soda.

Phosphated Syrup.—Syrupy phosphoric acid, 50 per cent., 2 oz.; phosphate of soda, 1 oz.; simple syrup, 1 gal. Flavor with either lemon or vanilla.

Pineapple Syrup.—1.—Proceed as for raspberry, but the hard nature of this fruit requires pounding with a heavy billet of wood (not metal) in a tub with a strong bottom; when well mashed it will require great pressure to extract all the juice from this fruit. A cider press will answer the purpose, and 14 lb. of sugar to a gallon of juice and a little pure acetic acid. Put it on a slow fire and stir until the sugar dissolves. When cold, bottle and tie down.

2.—Use pineapples of good flavor, cut or chop them up, and set aside from 24 to 36 hours; press and proceed as directed for strawberry syrup.

3.—Take a convenient number of the fruit; pare and mash them in a marble or porcelain mortar, with a small quantity of sugar; express the juice; for each quart of juice take 1½ pt. of water and 6 lb. of sugar; boil the sugar and water and add the juice; remove from the fire; skim and strain.

4.—Oil of pineapple, 1 dr.; tartaric acid, 1 dr.; simple syrup, 6 pt.

5.—Select a choice pineapple of good quality and ripe. One costing about 30 cents in proper season will make a gallon of syrup. Wash it thoroughly; then with a sharp knife remove the outer skin in a thin peeling. This is discarded. Now take a thicker slice from the outside of the fruit, just deep enough to include the eyes, and retain these in one of the pitcher containers. Now slice the remainder of the fruit down to the core and retain these slices in another pitcher. The slices containing the eyes and the core are now passed through the chopper, using the fine knives. A large amount of juice and pulp is obtained. Place in cheese cloth to strain, squeeze the pulp until it is free from juice and reject it. The second slicing is passed through the fine knives of the chopper and mixed with the juice already obtained. To the whole is then added enough rock candy syrup to make a gallon.

6.—Carbonated Pineapple Champagne. —Plain syrup, 42°, 10 gal.; essence of pineapple, 8 dr.; tincture of lemon, 5 oz.; carbonate of magnesia, 1 oz.; liquid saffron, 2½ oz.; citric-acid solution, 30 oz.; caramel, 2½ oz. Filter before adding the citric-acid solution and lime juice. Use 2 oz. to each bottle.

Pistachio for Dispensing.—To ½ gal. syrup add ½ oz. extract pistachio, ¼ oz. essence bitter almond. Condensed milk should be added for dispensing.

Prunes.—Set aside 1 lb. of the best prunes, with water enough to cover them, for several hours and repeat the washing several times. When they are completely washed add 1¼ pt. of distilled water and gradually heat the whole on sand bath. When the ebullition point is reached boil from 20 to 30 minutes and allow to cool. Place in a suitable vessel; and with the aid of a spatula make into a pulpy mass. When of the proper consistency remove to a half-gallon salt-mouthed glass jar and add 1 pt. of 95 per cent. alcohol. Set aside for 2 weeks, shake at intervals and press the juice out through a strong wet muslin strainer and filter. Two parts of this extract to 4 parts of syrup will be sufficient for making *Prune Syrup.*

Raspberries.—1.—Simple syrup, 6 pt.; water, 2 pt.; tartaric acid, 2 oz.; essence raspberry, 2 oz. Coloring sufficient. Coloring for raspberry, blackberry, etc., syrups may be made by boiling 1 oz. cochineal with ½ teaspoonful cream of tartar; filter.

2.—Take any quantity of fully ripe fruit; free them from stalks; place them in a tub and crush them with a wooden spatula; after they have been mashed, let them remain for 3 or 4 hours, and strain the crushed berries through a strong flannel bag or strainer into a suitable vessel. Dissolve ½ oz. citric acid in 3 oz. water and add this quantity to each gallon of juice; mix 14 lb. broken sugar to every gallon of juice; put on a slow fire and stir until all the sugar is dissolved (not boil); take off the fire and when cold bottle and cork for future use. If too thick when cold, it may be brought to a proper consistency by the addition of water.

3.—Take fresh berries and inclose them in a coarse bag; press out the juice, and to each quart add 6 lb. white sugar and 1 pt. of water; dissolve, raising it to the boiling point; strain; bottle and cork hot, and keep in a cool place. Raspberry syrup is improved by adding 1 part of currants to 4 parts of raspberries.

4.—Raspberries, 5 qt.; white sugar, 12 lb.; water, 1 pt. Sprinkle some of the sugar over the fruit in layers, allowing the whole to stand for several hours; express the juice and strain, washing out the pulp with the water; add the remainder of the sugar and water; bring the fluid to the boiling point and then strain. This will keep for a long time.

5.—Black raspberry juice, 8 oz.; gum foam, 1 dr.; simple syrup, enough to make 32 oz. It may be necessary to add a little cochineal coloring may be added to have the glass of soda the right shade.

6.—Raspberry juice, 32 oz.; granulated sugar, 3½ lb. Dissolve the sugar in the juice with the aid of heat. For use add 20 oz. of this to 40 oz. of simple syrup and tint to required color with a raspberry coloring.

7.—Proceed as directed for strawberry syrup.

8.—Artificial.—a.—Orris root (best), 1 oz.; cochineal, 2 dr.; tartaric acid, 2 dr.; water, 2 pt. Powder the orris root coarsely together with the cochineal; infuse in the water with the acid for 24 hours; strain, add 4 lb. of sugar, raise to the boiling point and strain again.

b.—Bruised orris root, 3 oz.; acetic acid, 2 oz.; acetic ether, 1 oz.; alcohol, 1 pt. Cochineal to color. Mix and allow to stand a few days; filter and use to flavor simple syrup.

Rose Syrup.—Simple syrup, 1 gal.; essence rose, 1 oz. Color pink with prepared cochineal and acidulate lightly with a solution of citric acid.

Royal Muscadine.—Raspberry syrup, 1 pt.; grape juice syrup, 1 pt.; raspberry vinegar, 2 oz. Mix. Pour 2 oz. into a mineral water glass, fill with carbonated water and serve.

Sangaree.—Make a syrup of 1 oz. tartaric acid, 1 dr. acetic acid, 8 oz. claret, 2 pt. port, enough syrup to make 1 gal. Serve 1 oz. solid in 8-oz. glass, filling with carbonated water.

Sarsaparilla.—1.—Oil of wintergreen, 10 drops; oil of anise, 10 drops; oil of sassafras, 10 drops; fluid ext. of sarsaparilla, 2 oz.; simple syrup, 5 pt.; powdered ext. of licorice, ½ oz.

2.—Simple syrup, 4 pt.; comp. syrup sarsaparilla, 4 fl.oz.; caramel, 1½ oz.; oil of wintergreen, 6 drops; oil of sassafras, 6 drops.

3.—Essence of sarsaparilla, 3 dr.; solution of caramel, 1 oz.; gum foam, 2 dr.; simple syrup, enough to make 32 oz.

4.—Sassafras bark, bruised, 1 lb.; licorice root, bruised, 7 oz.; water, 2½ gal.; oil of sassafras, 1½ dr.; oil of wintergreen, 2 dr.; alcohol, 95 per cent., 2 oz. Boil the sassafras and licorice in the water half an hour. Strain through flannel, then add the syrup. Dissolve the oils in the alcohol and add them to the syrup. Agitate the mixture freely.

Sherbet Syrup.—1.—Lemon essence, 2 dr.; orange essence, 2 dr.; pineapple juice, 4 oz.; solution citric acid, 2 oz.; syrup, ½ gal. Color with solution of cochineal.

2.—Vanilla syrup, 3 pt.; pineapple syrup, 1 pt.; lemon syrup, 1 pt.

Simple Syrup.—Take of white sugar (com.), 14 lb.; water, 1 gal. Dissolve with the aid of a gentle heat, strain and when cold add the whites of 2 eggs, previously rubbed with a portion of the syrup, and mix thoroughly by agitation. (The egg albumen is added to produce froth.)

Strawberry.—1.—Put 2 parts of strawberries deprived of the calyx, without crushing them, into a large-mouthed jar; add to them 2½ parts of sugar and frequently shake, keeping the vessel in a cool place. The sugar absorbs the juice, leaving the fruit shriveled and tasteless, the latter being removed by means of a strainer without pressure. Mix the clear syrup with 20% of alcohol.

2.—Proceed as for raspberry syrup 3, but the fruit, being more stubborn, will require a good beating with the spatula to mash them; when they have stood 3 or 4 hours, strain and press the juice out by squeezing the strainer between the hands. Add to the juice the same quantity of citric acid; dissolve in each gallon 14 lb. of loaf sugar; simply warm the juice sufficiently to dissolve the sugar; take from the fire, and when cold bottle and cork till required.

3.—Take of fresh ripe strawberries, 10 qt.; white sugar, 24 lb.; water, ¼ gal. Spread a portion of the sugar over the fruit, in layers, let it stand 4 or 5 hours, express the juice, strain, washing out the marc with water; add remainder of sugar and water, raise to the boiling point and strain.

4.—Use strawberries of a good flavor. Do not forget that if the berries possess no flavor, you cannot expect to obtain a syrup of fine flavor. Avoid also rotten berries, because unless you do, you may be sure to find as flavor the smell of the rotten berries in your syrup. Mash the fruit in a barrel or other suitable vessel, by means of a pounder, and leave the pulp for 12 or 24 hours at a temperature between 70 and 80°; stir occasionally, press, set the juice aside for one night, add for every pound avoirdupois of juice 1 oz. avoirdupois of cologne spirit or deodorized alcohol; mix, set aside for another night and filter through paper.

For 1 lb. of the filtered juice take 1½ lb. of sugar and heat to the boiling point, taking care to remove from the fire or turn off the steam as soon as the mixture begins to boil; remove the scum and bottle in perfectly clean bottles, rinsed with a little cologne spirit.

This syrup, as well as those made by the same process, is strong enough to be mixed with two or three times its weight of simple syrup for the soda fountain.

5.—Strawberry juice, 8 oz.; cochineal coloring 2 dr.; gum foam, 1 dr.; simple syrup, enough to make 32 oz. A good strawberry flavor is one of the hardest to get, and one of the most unsatisfactory. Still it is not advisable to be without even a poor article.

6.—Remove the hulls from a quart of strawberries and wash the berries in a strainer. Pass them through the chopper, using the coarse knives, and add rock candy syrup to make 2 qt.

Tea.—1.—Black tea, 3 oz.; green tea, 5 oz.; granulated sugar, 36 oz.; boiling water, 16 oz.

2.—Choice young Hyson tea, 8 oz.; hot water, 2 pt.; sugar, 4 lb. Infuse the tea, rolled or bruised into a coarse powder, for 2 hours in a tightly closed vessel. Strain and add to the sugar, dissolving the latter by agitation. Then add pure extract of vanilla, 1 oz.; pure cognac, 4 oz.; pure fruit juice (pineapple), 1 pt.; cane syrup or rock candy syrup, enough to make 1 gal.

3.—English breakfast tea, 1½ oz.; sugar, 1 lb.; boiling water, 2 pt. Infuse for 15 minutes; filter and dissolve the sugar in the filtrate. This drink is served in mineral glasses, with plenty of milk.

4.—Best green tea, 1 to 2 oz.; boiling water, 2 pt.; citric acid, ½ oz.; sugar, 56 oz. Infuse the tea in boiling water; strain the liquid, add enough water to complete 2 pt. and with the aid of a gentle heat dissolve in it the citric acid and the sugar. Strain the syrup through flannel and keep it in a cool place. Dispensed with soda water, this syrup makes a drink resembling *Iced Tea.*

Vanilla Syrup.—1.—White syrup, 2 gal.; citric acid, 1 oz.; extract vanilla, 2 fl.oz. The acid should be dissolved in a small quantity of the syrup before adding to the other ingredients.

2.—Fluid extract of vanilla, 1 oz.; simple syrup, 3 pt; cream (or condensed milk), 1 pt. May be colored with carmine.

3.—Simple syrup, 1 gal.; extract vanilla, 1 oz.; citric acid, ½ oz. Stir the acid with a portion of the syrup, add the extract of vanilla; mix.

4.—Simple syrup, 4 pt.; extract of vanilla, 2 oz.

5.—Tincture of vanilla, 4 dr.; solution of caramel, 4 dr.; gum foam, 2 dr.; simple syrup, enough to make 32 oz.

Violet Syrup.—Refined sugar, 5 kilos; fresh violets, tops of the flowers only, 0.525 kilo; water, 2,600 liters. Bruise the violets in a mortar; put in a water bath with 1.5 liter at 60° C. Agitate for some minutes and press out the flowers. Put them back in the water bath; add the rest of the boiling water; infuse for 12 hours; allow it to settle; add the sugar and dissolve by heat.

Whipped Cream.—1.—Secure cream as fresh as possible. Surround the bowl in which the cream is being whipped with cracked ice and perform the work in a cool place. As fast as the whipped cream rises, skim it off and place it in another bowl, likewise surrounded with ice. Do not whip the cream either too long or too violently The downward motion of the beater should be more forcible than the upward motion, as the first tends to force the air into the cream, while the second tends on the contrary to expel the air. A little powdered sugar should be added to the cream *after* it is whipped, in order to sweeten it. Make the whipped cream in small quantities and keep it on ice. The object of keeping the cream cool and avoiding too much beating is to prevent the formation of butter. The beating of the cream can be easily effected by means of the egg beater.

2.—Artificial.—Gelatine, 4 oz.; whites of 8 eggs; vanilla extract, 2 oz.; syrup, 1 gal. Dissolve the gelatine in water, beat the eggs, mix both with syrup, then with 9 gal. of water and charge at a pressure of about 100 lb.

Wintergreen Syrup.—Oil of wintergreen, 25 drops; simple syrup, 5 pt.; burnt sugar (to color), q. s.

FORMULAS

Comparative Cost of Carbonated Water.

Brought, per gal., $0.10; per portion of 8 oz., $0.0062. Made in tanks, per gal., $0.02; per portion of 8 oz., $0.0012. Made in automatic carbonator, per gal., $0.01; per portion of 8 oz., $0.0006.

NON-ALCOHOLIC BEERS

Beer Tonic.—Plain syrup, 22° Baume, 5 gal.; oil of wintergreen, 2 dr.; oil of sassafras, 2 dr.; oil of allspice, ½ dr.; oil of sweet orange, 2 dr. Mix the oil with 12 oz. of alcohol and add to the plain syrup. Then add 35 gal. of water at blood heat and ferment with sufficient yeast. To this add 1 dr. of salicylic acid dissolved in conjunction with 1 dr. of baking soda in a small glass of water. After it has ceased effervescing, add to the fermenting beer. The object of using this minute quantity is to prevent putrefactive fermentation. The natural vinous ferments will not be obstructed by it.

Birch Beer.—1.—Black birch bark, ½ lb.; hops, 1 oz.; pimento, ¼ lb.; ginger, ¼ lb.; golden syrup, 6 pt.; yeast, ½ pt., or 2 oz. of German yeast. Boil the bark in 3 or 4 pt. of water, and, when considerably reduced, strain and boil rapidly until the liquor is as thick as treacle. Meanwhile boil the hops, pimento and ginger in 6 qt. of water for 20 minutes, then strain it on the bark extract. Stir until it boils, add the golden syrup, and, when quite dissolved, strain the whole into a cask. Add 10 gal. of water previously boiled and allowed to cool, and as soon as it becomes lukewarm stir in the liquid yeast. Let it remain loosely bunged for 2 or 3 days or until fermentation has ceased, then strain into small bottles, cork them tightly and store in a cool place.

2.—Essence of wintergreen, ¼ oz.; essence of sassafras, ¼ oz.; essence of birch, 1 oz.; cinnamon (in powder), 1 teaspoonful; hops, 1 teacupful; yeast, 1 teacupful; sugar, a sufficiency; water, to make 1 gal. Macerate the essence, cinnamon and hops in the water for 12 hours, then add sugar to taste and the yeast. Set aside for a day or two to ferment; then strain and bottle.

Dandelion Root Beer.—1.—Tincture of ginger, 8 oz.; oil of wintergreen, 2 dr.; oil of sassafras, 1 dr.; fluid extract of dandelion, 1 oz.; fluid extract of wild cherry, 1 oz.; fluid extract of sarsaparilla, 1 oz.; diluted alcohol, enough to make 1 pt.

2.—Dandelion, 2 oz.; burdock root, 4 oz.; sarsaparilla, 4 oz.; sassafras, 2 oz.; caramel, 2 dr.; calamus, 4 dr.; oil of wintergreen, 30 m.; oil of sassafras, 30 m.; diluted alcohol, 1 pt.; alcohol, 2 oz.; water, a sufficient quantity. Mix the drugs, and, if not already powdered, reduce them to a coarse powder, moisten with the diluted alcohol, macerate and pack in the percolator and percolate with the remainder of the diluted alcohol and then with the water until the drugs are exhausted. Reserve the first 28 oz.; evaporate the weak percolate to 4 oz. and add to the reserved portion. Dissolve the oils in the alcohol, add to the percolate and filter, if necessary, through purified talcum or calcium phosphate.

Hop Beer.—1.—Percolate the following with a menstruum of 3 volumes of alcohol to 5 volumes of water until exhausted: Sassafras, 1 oz.; yellow dock, 1 oz.; wild cherry bark, ½ oz.; allspice, 1 oz.; wintergreen, 1 oz.; hops, ¼ oz.; coriander seed, ½ oz. To the percolate add 1 pt. of yeast and sufficient water to make 6 gal. and allow to ferment in a warm place. Or a fluid extract of the above can be made of one-half the strength of the drug and 2 oz. of the extract used for preparing a gallon of beer.

2.—Water, 5 qt.; hops, 6 oz. Boil 3 hours, strain the liquor, add water, 5 qt.; bruised ginger, 4 oz., and boil a little longer, strain and add 4 lb. of sugar; and when milk warm, 1 pt. of yeast. Let it ferment; in 24 hours it is ready for bottling.

3.—Hops, 6 oz.; water, 8 gal.; brown sugar, 2½ lb.; yeast, 3 or 4 tablespoonfuls Boil hops and water together for 45 minutes, add the sugar, and, when dissolved, strain into a bowl or tub. As soon as it is lukewarm add the yeast, let it work for 48 hours, then skim well, and strain into bottles or a small cask. Cork securely and let it remain for a few days before using it.

Lemon Beer.—1.—Boiling water, 1 gal.; lemon, sliced, 1; bruised ginger, 1 oz.; yeast, 1 teacupful; sugar, 1 lb. Let it stand 12 to 20 hours and it is ready to be bottled.

2.—Put in a keg 1 gal. of water, 1 sliced lemon, 1 tablespoon ginger, 1 pt. syrup, ½ pt. yeast. Ready for use in 24 hours. If bottled, tie down the corks.

Maple.—1.—To 4 gal. of boiling water add 1 qt. of maple syrup, ½ oz. of essence of spruce; add 1 pt. of yeast and proceed as with ginger pop.

2.—To 4 gal. of boiling water add 1 qt. of maple syrup ½ oz. essence of spruce and 1 pt. of yeast. Let it ferment for 24 hours and then strain and bottle it. In a week or more it will be ready for use.

3.—Boiling water, 6 gal; maple syrup, 1½ qt.; essence of spruce, ¾ oz.; add 1½ pt. yeast.

Molasses Beer.—Take 14 lb. molasses, 1½ lb. hops, 36 gal. water, 1 lb. yeast. Boil the hops in the water, add the molasses and ferment.

Ottawa Beer.—Sassafras, allspice, yellow dock, wintergreen, 1 oz. each; wild cherry bark and coriander, ½ oz.; hops, ¼ oz.; molasses, 3 qt. Put boiling water on the ingredients and let them stand 24 hours. Filter and add ½ pt. of brewer's yeast. Leave again 24 hours, then put it in an ice cooler, and it is ready for use. It is a wholesome drink, if it is used in moderation.

Root Beer.—1.—To 5 gal. of boiling water add 1½ gal. of molasses. Allow it to stand for 3 hours, then add bruised sassafras bark, wintergreen bark, sarsaparilla root, of each ¼ lb., and ½ pt. of fresh yeast, water enough to make 15 to 17 gal. After this has fermented for 12 hours it can be drawn off and bottled.

2.—Pour boiling water on 2½ oz. sassafras, 1½ oz. wild cherry bark, 2½ oz. allspice, 2½ oz. wintergreen bark, ½ oz. hops, ½ oz. coriander seed, 2 gal. molasses. Let the mixture stand 1 day. Strain, add 1 pt. yeast, enough water to make 15 gal. This beer may be bottled the following day.

3.—Sarsaparilla, 1 lb.; spicewood, ¼ lb.; guaiacum chips, ½ lb.; birch bark, ⅛ lb.; ginger, ¼ oz.; sassafras, 2 oz.; prickly ash bark, ¼ oz.; hops, ½ oz. Boil for 12 hours over a moderate fire with sufficient water, so that the remainder shall measure 3 gal., to which add tincture of ginger, 4 oz.; oil of wintergreen, ½ oz.; alcohol, 1 pt. This prevents fermentation. To make root beer, take of this decoction, 1 qt.; molasses, 8 oz.; water, 2½ gal.; yeast, 4 oz. This will soon ferment and produce a good, drinkable beverage. The root beer should be mixed, in warm weather, the evening before it is used, and can be kept for use either bottled or drawn by a common beer pump. Most people prefer a small addition of wild cherry bitters or hot drops to the above beer.

Sarsaparilla Beer.—Decoction of sarsaparilla compound, 2 oz.; sassafras root, bruised, ¼ oz.; honey, ¾ lb.; cane sugar, 1 lb.; fresh yeast, 4 oz.; distilled water, boiling, 1 gal. Dissolve the sugar and honey in the water, add the sassafras, and when cooled down, the sarsaparilla and yeast. Set aside in a warm place for a few days and then strain and bottle.

Spruce Beer.—1.—Sarsaparilla, 4 oz.; pipsissewa, 4 oz.; licorice root, 3 oz.; sassafras bark, 3 oz.; ginger root, 1 oz. Mix the drugs and grind to a coarse powder and extract by percolation with a menstruum of 3 parts of alcohol and 1 of water until 24 fl.oz. of product are obtained, and add the following: Oil lemon, 2 dr.; oil sassafras, 2 oz.; oil spruce, 2 oz.; oil wintergreen, 1 dr.; magnesia, 4 dr. Dissolve the oils in 6 oz. of alcohol and rub with magnesia and add 2 oz. of water and mix well. Now mix both solutions and filter. Use 4 or 5 oz. to 1 gal. of simple syrup and color with caramel.

2.—Hops, 2 oz.; chip sassafras, 2 oz.; water, 10 gal. Boil half an hour, strain; add brown sugar, 7 lb.; essence of spruce, 1 oz.; essence of ginger, 1 oz.; ground pimento, ½ oz. Put in a cask and cool, add 1½ pt. of yeast, let it stand 24 hours, fine, draw it off to bottle.

3.—Hops, 8 oz.; chip sassafras, 2 oz.; water, 10 gal. Boil half an hour, strain and add brown sugar, 7 lb.; essence of spruce, 1 oz.; essence of ginger, 1 oz.;

ground pimento, ½ oz. Put into a cask and cool, add 1½ pt. yeast, let it stand 24 hours, fine, draw it off to bottle.

4.—To 6 gal. of water add 1 pt. essence of spruce, 10 oz. of pimento, 10 oz. ginger, 1 lb. hops. After boiling about 10 minutes, add 24 lb. of moist sugar and 22 gal. of warm water. When the ingredients are well mixed and lukewarm, add 1 qt. yeast. Let it ferment 24 hours. Strain and bottle.

5.—Sugar, 1 lb.; essence of spruce, ½ oz.; boiling water, 1 gal.; mix well and when nearly cold add ½ wineglass of yeast and the next day bottle.

6.—Essence of spruce, ½ pt.; pimento and ginger (bruised), of each 5 oz.; hops, ½ lb.; water, 3 gal.; boil the whole for 10 minutes, then add of moist sugar, 12 lb.; water, 11 gal.; mix well and when lukewarm add 1 pt. of yeast. After the liquor has fermented for about 24 hours, bottle it.

7.—Water, 16 gal.; boil half, put the water thus boiled to the reserved cold half, which should be previously put into a barrel or other vessel; then add 16 lb. molasses, with a few spoonfuls of the essence of spruce, stirring the whole together; add ½ pt. of yeast, and keep it in a temperate situation with the bung hole open for 2 days, or till fermentation subsides; then close it up or bottle it off, and it will be fit to drink in a few days.

White Spruce Beer.—Five lb. loaf sugar are dissolved in 5 gal. of boiling water, then 2 fl.oz. of spruce are added. When almost cold add a gill of yeast. Place in warm place and after 24 hours strain through a piece of flannel and bottle.

EGG AND MILK OR CREAM

Egg Drinks.

Mixing Egg Drinks.—Draw desired syrup or syrups into glass; into shaker put q. s. crushed ice, break egg into shaker with one hand by holding egg in fingers, the thumb being made to give upward pressure on one end and third and fourth fingers on the other. Strike the egg on edge of shaker and pull apart in above manner. Put syrup into shaker with egg and ice and shake well, holding both thumbs against bottom of glass and fingers around shaker, moving arms outward from body. Strain into clean glass, wash ice out of shaker, then add soda, using fine stream freely.

Calisaya.—White and yolk of 1 egg, ½ tumblerful of cracked or shaved ice, 3 dashes of elixir calisaya, 1¼ oz. lemon syrup. Shake well, strain and add 1 tumblerful of plain soda. Pour from tumbler to shaker alternately several times, then grate nutmeg on top and serve.

Egg Sour.—Juice of 1 lemon; simple syrup, 12 dr.; 1 egg. Shake, strain and fill with soda. Mace on top.

Golden Fizz.—One egg yolk; catawba syrup, 1 oz.; juice of ¼ lemon; powdered sugar, 1 teaspoonful; cracked ice. Shake together and strain; then fill the glass with seltzer. A good morning drink.

Grape Egg Phosphate.—Orange syrup, 2 oz.; grape juice, 1 oz.; 3 dashes of phosphate; 1 egg; a little fine ice. Shake, fill with soda and strain.

Lemon Sour.—Lemon syrup, 12 dr.; juice of 1 lemon; 1 egg.

Lemonade.—1.—Break 1 egg in mixing glass, use 1 or 2 lemons, simple syrup to taste, shake well with ice, use fine stream of soda and serve in bell glass with nutmeg or cinnamon.

2.—In 1 pt. of water dissolve ½ lb. granulated sugar; squeeze in the juice of 4 large lemons and add a cupful cracked ice. Have ready the yolks and whites of 4 fresh eggs, well beaten, separately, the whites until stiff and dry; stir in the yolks with the lemonade, and, lastly, the whites; if necessary, add more sugar.

Phosphate.—1.—Put some cracked ice into a shaker, break in a fresh egg, add 1 oz. of American orange syrup and a dash of phosphate. Shake well, then strain into glass. Draw fine stream to make the drink creamy, then pour back and forth from a shaker to glass. Sprinkle top with grated nutmeg and serve with a straw.

2.—Small quantity cracked ice; lemon syrup, 1½ oz.; 1 egg; liquid phosphate, 30 drops. Shake together with hand shaker and add enough plain soda to fill the glass. Mix well by pouring from glass to shaker and serve, after adding a little grated nutmeg.

3.—Orange syrup, 1 oz.; pineapple syrup, 1 oz.; 1 egg; acid phosphate, 6 dashes; lemon juice, 6 dashes. Shake, strain and add soda water, using a fine stream freely. Sprinkle mace on top.

Pineapple.—Break a fresh egg into a 12-oz. soda-tumbler, add 1¼ oz. pineapple syrup, 2 dashes phosphate, 1 oz. plain water; shake thoroughly; fill shaker with fine stream soda, strain carefully into tumbler and serve.

Raspberry Sour.—Raspberry syrup, 12 dr.; 1 egg; juice of 1 lemon.

Silver Fizz (non-alcoholic).—Catawba syrup, 2 oz.; lemon juice, 8 dashes; white of 1 egg.

Vichy a la Egg.—One whole egg, ½ glass shaved ice, 1 oz. pure water. Shake thoroughly, then add slowly, while constantly stirring, enough vichy water to fill the glass.

Egg and Milk or Cream.

1.—One egg, ½ oz. of lemon and vanilla syrup, 1 oz. pure cream, 2 teaspoonfuls shaved ice. Shake and strain.

2.—Evaporated cream, 4 oz.; egg yolks, 4; extract vanilla, 1 oz.; syrup, 12 oz.

3.—One egg; vanilla or catawba syrup, 1 oz.; other syrups may be used; glass one-quarter full fine ice. Fill with milk and shake up well. Sprinkle nutmeg on top and serve.

4.—Cream, 6 oz.; pulverized sugar, 2 tablespoonfuls; 1 egg; shaved ice. Shake, strain and add soda water.

Chocolate.—1.—Chocolate syrup, 2 oz.; 1 egg; shaved ice; milk to fill glass; whipped cream. Shake egg, syrup, milk and ice together and strain; draw fine stream of soda to fill glass; use whipped cream on top.

2.—Chocolate syrup, 2 oz.; cream, 4 oz.; white of 1 egg.

Claret.—Claret syrup, 2 oz.; cream, 3 oz.; 1 egg.

Cocoa Mint.—Chocolate syrup, 1 oz.; peppermint syrup, 1 oz.; white of 1 egg; cream, 2 oz.

Coffee.—1.—Cream, 3 qt.; sugar, 1½ oz.; port wine, ½ oz.; 1 egg. Add a little ice, using a 12-oz. glass, fill with milk shake, strain into a clean glass and add a few dashes of nutmeg.

2.—Coffee syrup, 2 oz.; cream, 3 oz.; 1 egg; shaved ice.

Currant Cream.—Red currant syrup, 2 oz.; cream, 3 oz.; 1 egg.

Fruit Blend.—Pineapple syrup, ½ oz.; vanilla syrup, ½ oz.; orange syrup, ½ oz.; 1 egg; plain cream, 2 oz.; sherry wine, 2 dashes; ice, ¼ glass. Shake, strain, toss and serve.

Orange.—1.—Orange syrup, 1 oz.; catawba or pineapple syrup, 1 oz.; cream, 2 oz.; 1 egg.

2.—Orange syrup, 2 oz.; ice cream, 1 tablespoonful; one egg; milk, 3 oz.; cracked ice, q. s. This is put into a shaker and thoroughly mixed. It is served with cracked ice and enough plain soda to fill the glass. Served with straws.

Punch.—1.—Orange syrup, 2 oz.; lemon juice, 6 dashes; cream, 2 oz.; 1 egg.

2.—Break 1 egg in mixing glass, add 1 oz. catawba syrup, 1½ oz. brandy syrup, 2 oz. plain cream. Shake well with ice and use fine stream. Serve in bell glass.

Quince Flip.—Quince syrup, 2 oz.; cream, 3 oz.; 1 egg; shaved ice.

Rose Cream.—Rose syrup, 12 dr.; cream, 4 oz.; white of 1 egg.

Rose Mint.—Rose syrup, 6 dr.; mint syrup, 6 dr.; cream, 3 oz.; white of 1 egg.

Sherbet.—Sherry syrup, 4 dr.; pineapple syrup, 4 dr.; raspberry syrup, 4 dr.; cream, 2 oz.; 1 egg.

Sherry Flip.—Sherry syrup, 2 oz.; cream, 3 oz.; 1 egg. Shake, strain and add soda water. Mace on top.

Strawberry.—One egg in mixing glass, add 2 oz. of strawberry syrup, 2 oz. plain cream. Shake well with ice. Use fine stream and serve in bell glass.

Violet Cream.—Violet syrup, 12 dr.; cream, 4 oz.; white of 1 egg.

Milk or Cream.

Syrup (desired flavor), 1 oz.; shaved ice, ½ tumblerful; rich milk, ½ tumblerful. Shake vigorously and fill tumbler with plain soda from fine stream.

Banana. — Banana syrup, 12 dr.; cream, 4 oz.; 1 egg.

Chocolate.—1.—Chocolate syrup, 3 oz.; ice cream, 2 tablespoonfuls; milk, enough to fill a soda tumbler. Put into shaker, mix well and serve with cracked ice and straws.

2.—Chocolate syrup, 2 oz.; sweet milk, sufficient. Fill a glass full of shaved ice, put in the syrup and add milk until the glass is almost full. Shake well and serve without straining. Put whipped cream on top and serve with straws.

Clam Juice.—Clam juice, 1½ fl.oz.; milk, 2 fl.oz.; soda water, 5 fl.oz. Add a pinch of salt and a little white pepper to each glass; shake well.

Coffee.—Large glass chipped ice, ¼ full; coffee syrup, 2 oz.; sweet cream, 2 oz. Shake thoroughly and draw on soda in the shaker. Put a spoonful of whipped cream in the glass and pour in the drink, using the fine soda stream.

Mineral Milk.—Draw 6 oz. plain carbonated water into 8-oz. tumbler; fill with plain sweet cream; stir and serve.

Mint.—Mint syrup, 1½ fl.oz.; Angostura bitters, ½ fl.dr.; milk, 3 fl.oz. Carbonated water (coarse stream), enough to fill 8-oz. glass. Serve "solid."

Peach.—Peach syrup, 1 oz.; grape juice, ½ oz.; pineapple syrup, ½ oz.; shaved ice, ½ glass. Fill the glass with milk, shake well and serve with 2 straws.

Sherbet.—Shaved ice, ½ glass; strawberry syrup, 1 oz.; pineapple syrup, 1 oz.; vanilla syrup, 1 oz.; milk to nearly fill glass. Shake well, add soda water, fine stream, and pour from tumbler to shaker several times. Serve in a 12-oz. glass, with straws.

Strawberry. — Strawberry syrup, ½ oz.; vanilla syrup, ½ oz.; orange syrup, ½ oz.; brandy, 3 dashes; shaved ice, ¼ glass; milk, enough to fill glass. Top with whipped cream.

FRAPPES

Making Frappes.—Frappes are semi-frozen beverages, served in glasses or "ice cups," and are considered delicious drinks in the hot season. They are mainly composed of fruit juices, with an addition of sugar or syrup. They are also made of different kinds of punch, such as champagne, coffee, etc. In point of color they should correspond with the nature of fruit used. The freezing process should consist of the preparation being placed in a freezer or packer imbedded in broken salted ice, the vessel is twisted to the right and left alternately with the hand. As the composition becomes frozen up the sides of the can remove it with a palette knife by scraping it down into the composition and mix it with a spatula, remembering that frappe must be only half frozen, resembling snow, and just sufficiently liquid to admit of its being poured into glasses.

Blackberry.—Juice of 1 lemon; blackberry syrup, ½ oz.; raspberry syrup, ½ oz. Fill a 14-oz. glass two-thirds full of shaved ice. Shake well; don't strain; ornament with fruit and use real straws.

Chocolate.—Dissolve 1 lb. of chocolate (powdered) with 4 qt. of water, adding 2 lb. of sugar, seeing that the chocolate is fully dissolved; remove from the fire and strain. When cold, flavor with vanilla and freeze after the manner laid down for frappe.

Coffee.—1.—Java coffee syrup, 1½ lb.; coffee, about 5 oz. of best. Grind the coffee fresh every time you want to use it. Put 1 qt. of the cream into the farina boiler; when very hot add the coffee, stir well, cover the boiler, let it draw for 10 minutes, stir again, take off the fire and set in a warm place to settle, then pour off the clear part. Cook the rest of the cream, add the coffee and sugar, dissolve it, strain through fine muslin, cool and freeze. May also be served with whipped cream.

2.—To every quart of clear, good Mocha Coffee add 1 lb. of sugar and freeze as above.

Lemon.—Make an ordinary lemon water ice, rich in fruit flavor and good and sweet; then freeze.

Maple.—Two oz. maple syrup, 3 oz. plain cream, large teaspoonful of ice cream; shake well with ice, use only fine stream and serve in bell glass.

Orange.—1.—Orange syrup, 1 oz.; ice; then add in the following order: Powdered sugar, 1 tablespoonful; orange syrup, ½ oz.; lemon syrup, 2 dashes; raspberry syrup, 1 dash; acid-phosphate solution, ¾ oz. Fill the glass with soda water, stir well, strain into a mineral water glass and serve.

2.—Orange syrup, 1½ oz.; ice cream, 2 oz.; plain cream, 2 oz.; ice, ¼ glass. Shake, strain, toss and serve.

Pineapple.—Peel and crush 2 pineapples; then make a boiling syrup of 2½ lb. sugar and 2 qt. of water and pour it over the pineapples. Let it stand until nearly cold, then add the juice of 5 lemons: strain, press the liquid from the pineapples; pour into freezer, add 4 egg whites and freeze. Then work in a good ¼ pt. of maraschino.

Tea.—For tea frappe cover 3 tablespoonfuls of mixed tea with 2 qt. of boiling water. Let it stand about 10 minutes, then strain, sweeten to taste, cool and freeze to a mush.

GINGER ALES, BEERS, POP, ETC.

Ginger Ale.

Carbonated.—1.—To make the extract, proceed as follows: Bruised ginger, 128 parts; cardamom seed, 2 parts; oil lemon, ½ part; Cayenne pepper, 8 parts; alcohol dilute, 256 parts. Mix the aromatics, moisten with the alcohol, pack in a percolator and percolate until exhausted. Dissolve the oil of lemon in the percolate.

2.—To charge the fountains: Extract ginger ale, 6 dr.; acid solution, 6 dr.; syrup simplex, 5 pt.; sugar coloring (carmine), 2 dr.; water, 6 gal. Mix. Charge with carbonic-acid gas to 120 or 130 lb.

3.—The acid solution is made as follows: Citric acid, 3 oz.; water, 6 oz. Mix and make a solution.

Extract.—1.—Soluble essence of ginger, 1½ pt.; essence of lemon, soluble, 1½ oz.; essence of ginger oil, soluble, 1½ oz.; extract of vanilla, soluble, 1½ oz.; soluble essence rose oil, ¾ oz.; tincture cinnamon, soluble, 1½ dr.; artificial essence pineapple, ¾ dr.; essence capsicum, 3 dr.; mix.

2.—Tincture of ginger, 1 gal.; tincture of capsicum, 7½ oz.; extract of orange, 3 oz.; extract of lemon, ½ oz.; caramel, 5 oz.; water, 1½ gal.; sugar, 2 lb.; magnesium carbonate, 1 lb. Mix and allow to stand 12 hours. Shake occasionally and filter.

3.—Jamaica ginger, coarse powder, 4

oz.; mace, powder, ½ oz.; Canada snakeroot, coarse powder, 60 gr.; oil of lemon, 1 fl.dr.; alcohol, 12 fl.oz.; water, 4 fl.oz.; magnesium carbonate or purified talcum, 1 av.oz. Mix the first four ingredients and make 16 fl.oz. of tincture with the alcohol and water by percolation. Dissolve the oil of lemon in a small quantity of alcohol, rub with magnesia or talcum, add gradually with constant trituration the tincture and filter. The extract may be fortified by adding 4 av.oz. of powdered grains of paradise to the ginger, etc., of the above before extraction with alcohol and water.

4.—Capsicum, coarse powder, 8 oz.; water, 6 pt.; essence of ginger, 8 fl.oz.; diluted alcohol, 7 fl.oz.; vanilla extract, 2 fl.oz.; oil of lemon, 20 drops; caramel, 1 fl.oz. Boil the capsicum with water for 3 hours, occasionally replacing the water lost by evaporation, filter, concentrate the filtrate on a hot-water bath to the consistency of a thin extract, add the remaining ingredients and filter.

5.—Jamaica ginger, ground, 12 oz.; lemon peel, fresh, cut fine, 2 oz.; capsicum, powder, 1 oz.; calcined magnesia, 1 oz.; alcohol and water, of each sufficient. Extract the mixed ginger and capsicum by percolation so as to obtain 16 fl.oz. of water, set the mixture aside for 24 hours, shaking vigorously from time to time, then filter and pass through the filter enough of a mixture of 2 volumes of alcohol and 1 of water to make the filtrate measure 32 fl.oz. In the latter macerate the lemon peel for 7 days and again filter.

6.—To be used in the proportion of 4 oz. of extract to 1 gal. of syrup: Jamaica ginger, in fine powder, 8 lb.; capsicum, in fine powder, 6 oz.; alcohol, a sufficient quantity. Mix the powders intimately, moisten them with a sufficient quantity of alcohol and set aside for 4 hours. Pack in a cylindrical percolator and percolate with alcohol until 10 pt. of percolate have resulted. Place the percolate in a bottle of the capacity of 16 pt. and add to it 2 fl.dr. of oleoresin of ginger; shake, add 2½ lb. of finely powdered pumice stone and agitate thoroughly at intervals of one-half hour for 12 hours. Then add 14 pints of water in quantities of 1 pt. at each addition, shaking briskly meanwhile. This part of the operation is most important. Set the mixture aside for 24 hours, agitating it strongly every hour or so during that period. Then take oil of lemon, 1½ fl.oz.; oil of rose (or geranium), 3 fl.dr.; oil of bergamot, 2 fl.dr.; oil of cinnamon, 3 fl.dr.; magnesium carbonate, 3 fl.oz. Rub the oils with the magnesia in a large mortar and add 9 oz. of the clear portion of the ginger mixture, to which has been previously added 2 oz. of alcohol, and continue trituration, rinsing out the mortar with the ginger mixture. Pass the ginger mixture through a double filter and add through the filter the mixture of oils and magnesia. Finally pass enough water through the filter to make the resulting product measure 24 pt., or 3 gal. If the operator should desire an extract of more or less pungency, he may obtain his desired effect by increasing or decreasing the quantity of powdered capsicum in the formula.

Beer.

1.—Soluble essence of lemon, 1 oz., Jamaica ginger (bruised), 12 oz.; English honey, 12 oz.; lemon juice, 1 pt.; cane sugar, 9 lb.; distilled water, to make 9¼ gal.; white of an egg. Boil the ginger with 1½ gal. of water for half an hour, then add the sugar, honey and lemon juice, and make up with water to 9¼ gal. When cold, add the white of an egg and essence of lemon and stir well together. Set aside in a closed vessel for about 5 days and then bottle.

2.—Jamaica ginger, 2½ oz.; moist sugar, 3 lb.; cream tartar, 1 oz.; juice and peel of 2 lemons; brandy, ½ pt.; good ale yeast, ¼ pt.; water, 3½ gal. This will produce 4½ doz. bottles of excellent ginger beer, which will keep 12 months. Boil the ginger and sugar for 20 minutes in the water, slice the lemons and put them and the cream of tartar in a large pan; pour the boiling liquor over them and stir well; when milk is warm, add the yeast; cover and let it remain 2 or 3 days, skimming frequently; strain through a cloth into a cask and add the brandy. Bung down very close; at the end of 2 weeks draw off and bottle, cork very tightly. If it does not work well, add a very little more yeast.

3.—Brown sugar, 2 lb.; boiling water, 2 gal.; cream of tartar, 1 oz.; bruised ginger root, 2 oz. Infuse the ginger in the boiling water, add your sugar and cream of tartar; when lukewarm strain; then add ½ pt. good yeast. Let it stand all night; then bottle; if you desire, you can add 1 lemon and the white of an egg to fine it.

4.—*English.*—Water, 3 gal.; pulverized ginger, 3 oz.; sugar, 4 lb.; cream tartar, 4 oz. Boil and when cold add 2 tablespoonfuls of yeast. Allow it to stand over night, then filter and bottle.

5.—*Fermented.*—For a good recipe for

fermented ginger beer to put up in stone jugs, take best Jamaica ginger, ground, 1 lb.; tartaric acid, 6 oz.; gum arabic, 1 lb.; oil lemon, ½ oz.; sugar, 21 lb.; water, 21 gal.; yeast, ½ pt. Stir the ginger, sugar and water very thoroughly together. Dissolve the gum in sufficient water to give it the consistency of cream; to this add the lemon oil and shake them well together. Add this mixture to the sugar solution. Now stir in the yeast. As soon as a brisk fermentation is established, strain through a jelly bag. Let it work for another day or two and then bottle. This will make 20 gal.; you can double or quadruple the proportions if you want to make a larger batch.

6.—*Powder.*—a.—Jamaica ginger, powdered, 1 oz.; sodium bicarbonate, 7 oz.; sugar, 1¾ lb.; oil of lemon, 1 fl.dr. Make into powders.

b.—Ginger, bruised, ½ oz.; cream of tartar, ¾ oz.; essence of lemon, 4 drops. Mix. Some sugar may be added if it be thought desirable to make the packet look bigger. For use this powder is to be added to 1 gal. of boiling water, in which dissolve 1 lb. of lump sugar, and when the mixture is nearly cool 2 or 3 tablespoonfuls of yeast are to be added. The mixture should be set aside to work for 4 days, when it may be strained and bottled.

Gingerade.

Dissolve 3 lb. granulated sugar in 2 gal. of water. Then add the well-beaten whites of 3 eggs and 2 oz. powdered ginger. It is well to moisten the ginger before adding it to the whole with just a little water. Now place over the fire in an enameled saucepan, bring slowly to the boiling point, skim and stand aside to settle. When cold, add the juice of 1 large lemon and ¼ oz. yeast, dissolved in 2 tablespoonfuls of warm water. Mix thoroughly, strain, fill the bottles, cork tightly and tie the corks, putting them at once in a cool place. Ready for use in 2 days.

Mint.

Lemon syrup, 4 oz.; ginger syrup, 12 oz.; tincture capsicum, 2 dr.; tincture menth. vir., ½ dr. Mix, serve with shaved ice and straws. Decorate with mint leaves.

Pop.

1.—Five lb. of cream of tartar; ginger, 8 oz.; sugar, 35 lb.; essence of lemon, 5 dr.; water, 30 gal.; yeast, 2 qt.

2.—Take 5½ gal. water; ginger root (bruised), ¾ lb.; tartaric acid, ½ oz.; white sugar, 2¼ lb.; whites of 3 eggs, well beaten; 1 small teaspoonful lemon oil; 1 gill yeast. Boil the root for 30 minutes in 1 gal. water; strain and put the oil in while hot; mix. Make over night; in the morning skim and bottle.

3.—Five lb. of loaf sugar to 5 gal. of cold water, 4 lemons, 2 oz. white root ginger, 4 oz. cream tartar. Boil the sugar and ginger (previously pound the latter); when it has boiled 15 minutes strain it through a flannel cloth into a large crock, put in the cream tartar, slice also the lemon into it; let it stand until milk-warm, then add a teacup of yeast; let it stand a little, then bottle it tightly in stone bottles; in 3 days it will be fit for use.

4.—*Imperial.*—Cream of tartar, 3 oz.; ginger, 1 oz.; white sugar, 24 oz.; lemon juice, 1 oz.; boiling water, 1½ gal. When cool, strain and ferment with 1 oz. yeast. Bottle.

5.—*Royal Pop.*—To 3 gal. of water add ½ lb. cream tartar, ¾ oz. ginger, 3½ lb. white sugar, ½ dr. essence of lemon, ½ pt. yeast. The corks should be tied down.

GLACES

Glaces should be served in small, handsome punch glasses, with small spoons to match.

Claret.—Lemon, 1 oz.; claret, 1 oz.; cream, 2 oz.; cracked ice, ½ glassful. Shake, strain, draw coarse stream into shaker, to fill a 12-oz. glass. Toss and serve with 2 straws stuck through a slice of lemon in glass.

Crushed Fruit.—Crushed fruits served in the following manner make a delicious and refreshing drink: Crushed fruit, 12 dr.; juice of half a lemon; shaved ice. Put the ice into a small glass, add the fruit and lemon juice, stir well and serve with a spoon and straws.

Pineapple.—a.—Two spoonfuls crushed pineapple, ½ oz. pineapple syrup, shaved ice.

b.—Pineapple snow is a mixture of shaved or cracked ice, cream and pineapple syrup with or without carbonated water, the whole being topped off with shaved ice and dispensed in a glass with a spoon.

c.—Pineapple syrup, 1 oz.; powdered sugar, 1 teaspoonful; shaved ice, ½ glassful. Add some carbonated water, stir vigorously in a shaker, strain into an 8-oz. glass, fill the latter with the coarse stream of carbonated water, stir again and add a piece of pineapple or some crushed pineapple.

GRAPE JUICE

Flavor and Quality.—In the making of unfermented grape juice a great deal of judgment can be displayed and many variations produced so as to suit almost any taste by the careful selection of the varieties of grapes from which it is made.

Equally as pronounced variations in color can be had, as, for instance, almost colorless, yellow, orange, light red, red and a deep purple.

Unfermented grape juice may be made from any grape; not only this, but unfermented juice is made from other fruits as well; for instance, apples, pears, cherries and berries of different kinds. The richer, sweeter and better in quality the fruit, the better will be our unfermented juice. If, on the other hand, the fruit is sour, green and insipid, the juice will be likewise.

Fermentation.—Fermentation may be prevented in either of two ways.

1.—By chemical methods, which consist in the addition of germ poisons or antiseptics, which either kill the germs or prevent their growth. Of these the principal ones used are salicylic, sulphurous, boracic and benzoic acid, formalin, fluorides and saccharins. As these substances are generally regarded as adulterants and injurious, their use is not recommended.

2.—Mechanical means are sometimes employed. The germs are either removed by filtering or a centrifugal apparatus, or they are destroyed by heat, elctricity, etc. Of these, heat has so far been found the most practical.

Practical tests so far made indicate that grape juice can be safely sterilized at from 165 to 176° F. At this temperature the flavor is hardly changed, while at a temperature much above 200° F. it is. This is an important point, as the flavor and quality of the product depend on it.

This information is intended for the farmer or the housewife only. Readers who desire to go into the manufacture of grape juice in a systematic manner for commercial purposes are referred to Bulletin 24, Bureau of Plant Industry, Department of Agriculture, on the same subject.

Home Manufacture.—Use only clean, sound, well-ripened but not over-ripe grapes. If an ordinary cider mill is at hand, it may be used for crushing and pressing, or the grapes may be crushed and pressed with the hands. If a light-colored juice is desired, put the crushed grapes in a cleanly washed cloth sack and tie up. Then either hang up securely and twist it or let two persons take hold, one on each end of the sack (Fig. 1) and twist until the greater part of the juice is expressed. Then gradually heat the juice in a double boiler or a large stone jar in a pan of hot water, so that the juice does not come in direct contact with the fire, at a temperature of 180 to 200° F.; never above 200° F. It is best to use a thermometer, but if there be none at hand heat the juice until it steams, but do not allow it to boil. Put it in a glass or enameled vessel to settle for 24 hours. Carefully drain the juice from the sediment and run it through several thicknesses of clean flannel, or a conic filter made from woolen cloth or felt may be used. This filter is fixed to a hoop of iron, which can be suspended wherever necessary (Fig. 2). After this fill into clean bottles. Do not fill entirely, but leave room for the liquid to expand when again heated. Fit a thin board over the

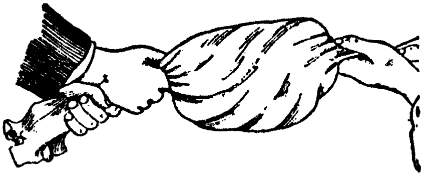


Fig. 1.—Cloth Hand Press

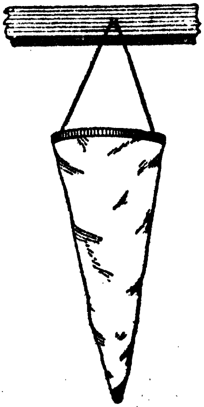


Fig. 2.—Cloth or Felt Filter

bottom of an ordinary wash boiler (Fig. 3), set the filled bottles (ordinary glass fruit jars are just as good) in it, fill in with water around the bottles to within about an inch of the tops and gradually heat until it is about to simmer. Then take the bottles out and cork or seal immediately. It is a good idea to take the further precaution of sealing the corks over with sealing wax or paraffin to prevent mold germs from entering through the corks. Should it be desired to make a red juice, heat the crushed grapes to not above 200° F., strain through a clean cloth or drip bag, as shown in Fig. 4 (no pressure should be used), set away to cool and settle and proceed the same as with light-colored juice. Many people do not even go to the trouble of letting the juice settle after straining it, but reheat and seal it up immediately, simply setting the vessels away in a cool place in an upright position where they will be undisturbed. The juice is thus allowed to settle, and when wanted for use the clear juice is simply taken off the sediment. Any person familiar with the process of canning fruit can also preserve grape juice, for the principles involved are identical.

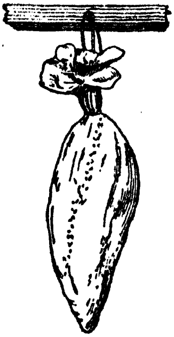


Fig. 4.—Drip Bag

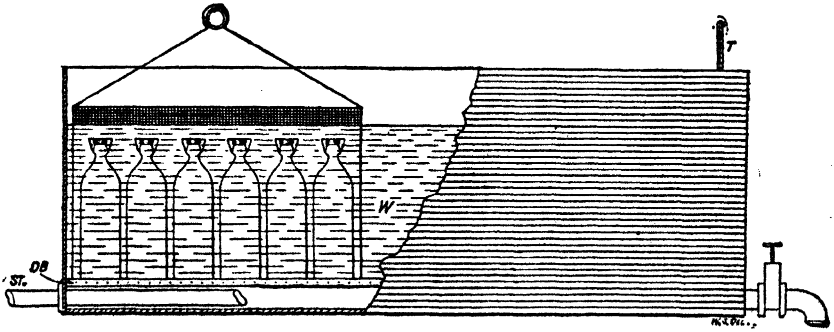


FIG. 3.—PASTEURIZER FOR JUICE IN BOTTLES

DB, double bottom. ST, steam pipe. W, water bath. T, thermometer. (Bottle shows method of adjusting a cord holder of sheet metal.)

One of the leading defects so far found in unfermented juice is that much of it is not clear, a condition which very much detracts from its otherwise attractive appearance and due to two causes already alluded to. Either the final sterilization in bottles has been at a higher temperature than the preceding one or the juice has not been properly filtered or has not been filtered at all. In other cases the juice has been sterilized at such a high temperature that it has a disagreeable, scorched taste. It should be remembered that attempts to sterilize at a temperature above 195° F. are dangerous, so far as the flavor of the finished product is concerned.

Another serious mistake is sometimes made by putting the juice into bottles so large that much of it becomes spoiled before it is used after the bottles are opened. Uufermented grape juice properly made and bottled will keep indefinitely, if it is not exposed to the atmosphere or mold germs; but when a bottle is once opened it should, like canned goods, be used as soon as possible, to keep it from spoiling.

A description of the manufacture of grape juice in larger quantities may be found in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1441.

Formulas.

1.—The juice as it comes, being too sweet to drink, should be prepared by the following formula and kept on ice ready to serve: Bottled grape juice, 2 pt.; water, 2 pt. A small amount of cracked ice should be added.

2.—Make a plain soda lemonade and only fill the glass within 1 inch of the top. Over this pour carefully ½ inch of the pure grape juice. This is a delicious drink.

3.—Put in the bottom of a wineglass 2 tablespoonfuls of grape juice; add to this the beaten white of 1 egg and a little chopped ice; sprinkle sugar over the top and serve. This is often served in sanitariums.

Bohemian Cream.—One pt. thick cream, 1 pt. grape-juice jelly; stir together; put in cups and set on ice. Serve with lady fingers.

Besides the recipes just given many more are enumerated, such as grape ice, grape lemonade, grape water ice, grape juice and egg, baked bananas, snow pudding, grape gelatine, junket and grape jelly, tutti-frutti jelly, grape float, grape jelly, grape juice plain, grape soda water and scores of others.

Cocktail.—Don't Care syrup, 1½ oz.; grape juice, 3 oz; half 12-oz. glass of shaved ice and soda water to fill. Finish with maraschino cherries and serve with straws and spoon. Ap.

Egg Phosphate.—Grape syrup, 1 oz.; egg, one; phosphate, 3 dashes; 1 teaspoonful of ice. Shake and proceed in making an egg phosphate.

Grape Cup.—Grape juice, 1 pt.; English breakfast tea (concentrated), 1 oz.; prepared lime juice, 4 oz.; acid solution phosphate, ½ oz.; 1 pt. water. Add a lump of ice and let stand until cold. Fill glass three-quarters full and fill with plain soda as it is served.

Lemonade.—Fill glass two-thirds full of fine ice; juice of 1 lemon; grape syrup, 1½ oz.; shake and fill with soda. Decorate with slice of lemon.

Malted Grape.—Make a malted syrup, using 12 oz. of extract of malt and 6 oz. of simple syrup. To serve, use 1¼ oz. of this syrup, ½ oz. of pure Concord grape juice and fill the glass with soda.

Nectar.—Take the juice of 2 lemons and 1 orange, 1 pt. of grape juice, 1 small cup of sugar and 1 pt. of water. Serve ice cold. If served from punch bowl, iced lemon and orange add to the appearance.

Pineapple.—Into a 12-oz. glass draw 1½ oz. of pineapple, syrup and add 2 oz. of Concord grape juice, 1 oz. of sweet cream and a little finely shaved ice. Shake thoroughly and add enough carbonated water to fill the glass, using the fine stream mostly. Strain into a clean glass and serve.

Punch.—1.—Boil together 1 lb. of sugar and ½ pt. of water until it spins a thread; take from the fire and when cold add the juice of 6 lemons and 1 qt. of grape juice. Stand aside over night. Serve with plain water, apollinaris or soda water.

2.—Into a 12-oz. glass, 2 oz. plain syrup, fill glass half full fine shaved ice, 3 oz. grape juice, fill glass with carbonated water, stir and top off with slice pineapple or orange.

3.—Fill glass two-thirds full of shaved ice; grape juice, 1 oz.; orange syrup, 1 oz.; lemon juice, 1 dash; Jamaica ginger, 1 dash. Fill with soda, mix and decorate with a slice of pineapple and cherry.

4.—Pine apple syrup, 1 oz.; pure grape juice, 1 oz.; lime juice, 3 dashes. Two-thirds glass of ice. Fill with soda and decorate with a slice of pineapple.

5.—Lemon syrup, 1 oz.; grape juice, 1 oz.; orange water ice, 1 scoop. Shake and fill glass with soda. Serve still and decorate with a slice of lemon and orange.

6.—Into a 12-oz. glass draw 1½ oz. of grape syrup, 1 oz. of grape juice. Add 3 dashes of lemon juice. Fill one-third full of orange water ice and balance with carbonated water. Mix and decorate.

7.—Into a 12-oz. glass draw 1½ oz. of orange syrup. Into this squeeze the juice of ½ lemon and add 1 oz. of grape juice. Fill one-third full of ice and balance with carbonated water. Mix and decorate.

Sherbet.—Orange syrup, 2 fl.oz.; grape juice, 2 fl.oz. Draw into a 12-oz. glass, half fill the latter with shaved ice, then fill it with plain water, stir with a spoon and serve with straws.

For 8 persons mix 1 pt. of grape juice (unfermented), juice of lemon and 1 heaping tablespoonful of gelatine, dissolved in boiling water; freeze quickly; add beaten white of 1 egg just before finish.

Syllabub.—Fresh cream, 1 qt.; whites of 4 eggs; grape juice, 1 glass; powdered sugar, 2 small cups; whip half the sugar with the cream, the balance with the eggs; mix well; add grape juice and pour over sweetened strawberries and pineapples or oranges and bananas. Serve cold.

ICE CREAM BEVERAGES

Banana.—1.—Slice a banana in two. Place a spoonful of vanilla ice cream in the center and top off with maraschino cherries and pour cherry syrup over it.

2.—Into a 12-oz. glass draw 1 oz. of sweet cream and 1 oz. of vanilla syrup; into this slice half a banana; add a portion of ice cream; shake thoroughly, then fill the glass with soda, using the fine stream only. Pour without straining into a clean glass and top off with whipped cream. Serve with a spoon.

3.—Peel and split a banana, lay both halves together on the bottom of a large saucer. On the top of the banana put a cone-shaped measure of ice cream and over this pour a little crushed pineapple, a few powdered nuts, a spoonful of whipped cream. Top with a cherry.

4.—Split a banana lengthwise and cover with a portion of 3 kinds of ice cream and 1 water ice, so arranging the ice cream as to make the colors contrast nicely.

Cantaloupe.—1.—Take ½ cantaloupe, cut off a piece of bottom so it will stand, add a No. 12 scoop of vanilla cream, and, if possible, watermelon ice. If this is impossible, substitute what water ice you may have on hand. Over this pour 1 ladle of crushed raspberries, top with nuts, whipped cream and a cherry and place mint leaves on the side.

2.—Cut a cantaloupe in halves, take out the seeds and fill in with ice cream, grate nutmeg over it. Serve on thin china dish with soda spoon. The cantaloupe should be kept ready ice cold.

Celery Cocoa Cream.—One oz. chocolate paste, 1 oz. cream, 4 dashes essence of celery. Stir while filling up with hot soda. Top off with whipped cream and serve with celery salt.

Cherry Cream.—Spoonful ice cream in 8-oz. stem glass. Almost fill with shaved ice. Add 2 oz. cherry syrup, top with layer of ice cream and add a marschino cherry.

Chocolate.—Put the proper amount of chocolate syrup into the glass. Then run in enough carbonated water to half fill the glass. Next put in a lump of vanilla ice cream the size of an egg. Then draw on the fine stream of carbonated water and top off the whole with a tall, foaming billow of whipped cream.

Cream Puff.—Break a fresh egg into a shaker, draw an ounce of orange syrup, add a good-sized spoonful of ice cream and shake very thoroughly. Then without straining fill the shaker with fine stream. Pour from shaker to glass, top with grated nutmeg and serve with a straw. Chocolate Cream Puff and Coffee Cream Puff may be made by using the syrups named instead of orange.

Creamade.—Juice from ½ lime; orange syrup, 1 oz.; pineapple syrup, 1 oz.; cream, 2 oz.; ice cream, ½ oz. Shake, fill the glass with the fine stream and top with a slice of pineapple.

Cucumber a la Surprise.—Line the halves of a long cucumber mold with a good-colored (not over-colored) green gage or other green water ice and fill in with lemon ice cream. Close the mold and freeze in the usual manner. Serve plain on a white china dish. In the season 1 or 2 natural leaves may be used on the dish under the cucumber.

Fig Souffle.—Cut a large fig into quarters, mix with vanilla ice cream and serve in a stem ice cream glass.

Fruit.—1.—Shaved ice, ½ tumbler; ice cream, 1 tablespoonful; pure milk, 1 oz.; extract of vanilla, 1 dash; crushed strawberry, 1 teaspoonful; crushed pineapple, 1 teaspoonful; crushed raspberry, 1 teaspoonful; catawba syrup, 1½ oz. Shake well, then add plain soda. Ap.

2.—Crushed strawberries, ½ oz.; crushed peaches, ½ oz.; ice cream to fill small glass.

Ice Cream Shake.—One egg, 1 oz. marshmallow syrup, small quantity of ice cream.

Maple.—In a large shaking glass put 4 oz. ice cream, 2 oz. maple syrup and 1 oz. plain cream. Shake and when thoroughly shaken fill with fine stream.

Marshmallow.—Orange flower water, 4 oz.; gum arabic, 12 dr.; extract vanilla, ½ oz.; syrup, q. s. 8 pt. Mix. Serve with ice cream.

Nut Bamboo Souffle.—Ladle ice cream on fancy plate; add 1½ oz. coffee syrup and shredded cocoanut mixed; dress with whipped cream, whole dates, seeded and fancy whole cherries.

Orange.—Shaved ice, ½ tumblerful; 1 egg; vanilla syrup, 1 oz.; orange syrup, 1 oz.; ice cream, 1 tablespoonful. Fill the glass nearly full of cream, shake well and add a little soda water.

Peach.—1.—Two oz. raspberry syrup, 2 tablespoonfuls peach ice cream. Serve as ice-cream soda.

2.—Peel about 1 doz. ripe, yellow, good-flavored peaches; slice fine into a dish and cover with about as much sugar as you have of fruit. Mash together thoroughly until the sugar is dissolved, then add an equal amount of simple syrup. This mixture will not keep fresh for more than 2 days. Serve as ice-cream soda.

3.—Shaved ice, ½ tumblerful; ice cream, 1 tablespoonful; fresh cream, 1 oz.; extract of peach, 1 dash; crushed peach, 1 tablespoonful; peach syrup, 1 oz.; plain soda (fine stream), 1 tumblerful.

Pineapple.—Pineapple syrup, 2 oz.; cream, 2 oz.; 1 egg; ice cream, 1 large ladle. Cinnamon may be added if desired. Shake add serve with slice of pineapple.

Sandwiches.—Take lady fingers, separate and spread ice cream, either vanilla, lemon or strawberry, between each slice; place together and serve on plate.

LEMON, LIME, MINT, ETC.

1.—Take a little cracked ice and squeeze the juice of 2 limes. Add powdered sugar q. s. and 1 egg. Shake well together and strain into a glass and fill up with carbonic water. Cover top with cracked ice and insert 2 or 3 stalks of mint. Add a touch of nutmeg and 1 or 2 strawberries.

2.—Juice of half an orange, juice of half a lemon, 2 tablespoonfuls pineapple juice, 2 tablespoonfuls powdered sugar, ½ glass crushed ice. Fill glass with water, shake well and serve with straws.

Lemon.

1.—Peel off the yellow rinds from 1 doz. fresh lemons, taking care that none of the rind is detached, but the yellow zest—that portion in which the cells are placed containing the essential oil of the fruit. Put these rinds into an earthen vessel, pour over them 1 pt. of boiling water and set aside in a warm situation to infuse. Express the juice from 2 doz. lemons, strain it into a porcelain bowl and add 2 lb. of fine white sugar, 3 qt. water and the infusion from the peels. Stir all well together until the sugar is completely dissolved. Now sample and if required add more acid or more sugar; take care not to have it too watery; make it rich with plenty of fruit juice and sugar.

2.—To the juice of 6 lemons and the yellow rind of 2 lemons add ½ lb. of sugar and 1 qt. of water. Ice the lemonade. Water may be added according to taste afterward.

3.—Peel off the rind, cut the lemon in two and squeeze the juice into a glass, add 2 tablespoonfuls powdered sugar, chipped ice and water; shake well and strain into a thin glass in which a little shaved ice has been placed; decorate with fruits and serve with straws. Soda lemonade may be made by adding soda water in place of plain water.

4.—Strain the juice of 1 lemon into ½ pt. of cold water, sweeten to taste, then stir in ¼ teaspoonful carbonate of soda, and drink while the mixture is in an effervescing state.

Apollinaris.—Juice of 1 lemon; powdered sugar, 1 spoonful; cracked ice, ¼ glass. Shake, strain and fill with apollinaris water, add 2 cherries and slice of lemon.

Artificial.—1.—Loaf sugar, 2 lb.; tartaric acid, ½ oz.; essence of lemon, 30 drops; essence of almonds, 20 drops. Dissolve the tartaric acid in 2 pt. hot water, add the sugar and lastly the lemon and almond; stir well, cover with a cloth and leave until cold; put 2 tablespoonfuls into a tumbler and fill up with cold water. This drink, it is said, will be found much more refreshing and more palatable than either ginger beer or lemonade and costs only 30 cents for 10 pt. The addition of a very little bicarbonate of potash to each tumblerful just before drinking will give a wholesome effervescing drink.

2.—Succus Limonium Factitius.—Citric or tartaric acid, 2¼ oz.; gum, ½ oz.; pieces of fresh lemon peel, ¾ oz.; loaf sugar, 2 oz.; boiling water, 1 qt.; macerate with occasional agitation till cold and strain. Excellent.

3.—Water, 1 pt.; sugar, 1 oz.; essence of lemon, 30 drops; pure acetic acid to acidulate. Inferior. Both are used to make lemonade.

Boiled Lemonade.—1.—The juice of 3 lemons, 5 tablespoonfuls of sugar and 1 cupful boiling water added to the lemons and sugar. Set aside to cool. When ready for use, put in lemonade glasses with cracked ice and dilute with water.

2.—Allow 3 lemons to each qt. of water and about ½ lb. of sugar. Have the lemons perfectly clean, cut 2 thin slices from the center of each and lay aside. Chip off some of the thin yellow rind from several of the lemons and squeeze out the juice, pressing hard enough to extract some of the flavor of the skin. Put the juice, the clipped rind and the sugar in a large bowl; then pour on the desired amount of boiling water. Let it stand until cold, put away in the ice chest and when ready to serve fill the glasses one-third full of cold water or chipped ice; add the lemon water and a slice of the cut lemon. A maraschino cherry may be added.

Claret.—One-third glass cracked ice, 1 lemon, 2 oz. claret syrup. Shake well and add a glassful of plain soda. Stir, strain and add 1 slice lemon. Serve with 2 straws.

Diabetic Lemonade.—Citric acid, 5 grams; glycerine, 20 to 30 grams; water, 1,000 c.c.

Egg.—1.—Break 1 egg into a glass, beat it slightly, then add 1 dessertspoonful of lemon-juice sugar to taste, 1 tablespoonful of crushed ice and a little cold water. Shake well until sufficiently cooled, then strain into another glass, fill up with iced water, sprinkle a little nutmeg on the top and serve.

2.—Break 1 egg in mixing glass, use 1 or 2 lemons, simple syrup to taste. Shake well with ice. Use fine stream of soda and serve in bell glass with nutmeg or cinnamon.

3.—Beat the white of an egg light and add to plain lemonade.

4.—Pour a pint of boiling water over a cup of sugar, the juice of 4 lemons and the thin, yellow rind of 2; cool, then chill. Beat the yolks of 4 eggs until lemon colored and thick, and then the whites until stiff. Mix them thoroughly; add the lemon water and a pint of fine chipped ice or ice-cold water and serve.

Fruit.—Crush 6 fine strawberries or raspberries well, add 1 teaspoonful of castor sugar, small or otherwise according to taste, the juice of 1 lemon, a little cold water and strain into a tumbler. Add a little chushed ice, fill up with cold water and serve.

Lemon Squash.—This is made in the same manner as lemonade, only leaving in the crushed halves of the lemon.

Milk.—1.—Dissolve ¾ lb. loaf sugar in 1 pt. boiling water and mix with 1 gill lemon juice and 1 gill sherry; then add 3 gills cold milk. Stir the whole well together and then strain it.

2.—Take 4 lemons, pare the rind as thin as possible; squeeze them into 1 qt. water, add ½ lb. fine sugar; let it stand 2 or 3 hours and pass it through a jelly bag.

3.—Effervescing (without a machine). —Put into each bottle 2 dr. sugar, 2 drops essence of lemon, ½ dr. bicarbonate potash, and water to fill the bottle; then drop in 35 or 40 gr. of citric or tartaric acid in crystals and cork immediately, placing the bottles in a cool place or preferably in iced water.

4.—Sesquicarbonate of soda, 2 scruples; sugar, 2 dr.; essence of lemon, 4 drops; water, ½ pt.; lastly, 8 dr. tartaric acid in crystals. Care must be taken to avoid accidents from the bursting of the bottles.

5.—Into a soda-water bottle nearly filled with water put 1 oz. sugar; essence of lemon (dropped on the sugar), 2 drops; bicarbonate of potash in crystals, 20 gr., and, lastly, 30 to 40 gr. of citric acid, also in crystals. Cork immediately.

Pineapple.—1.—Carefully boil 1 lb. of sugar in 1 qt. of water until it forms a thin syrup, removing all scum as it rises. Set it to cool. Meantime squeeze the juice of 4 lemons into a dish. Peel a large, ripe pineapple, remove the eyes and grate it into a large punch bowl. Add the lemon juice and stir it well through the pineapple. Then stir in the syrup. Let the mixture stand a couple of hours and then add 1 qt. of ice water. Put a big lump of ice in a punch bowl, strain the mixture through a fine sieve into the bowl, ornament the top with cut fruits and serve in glass cups.

2.—For pineapple lemonade use the juice of 4 small lemons, a can of shredded pineapple, a cupful of sugar and 4 cupfuls of water. Make a syrup of the sugar and water and cool it before adding the lemon juice.

Preservation of Lemon Juice.—Agitate a prolonged time with finest powdered talcum, filter, add sugar, boil and then fill hot into bottles and seal white still hot.

Powder.—1.—Take 1 oz. crystallized citric acid, rub it fine and mix thoroughly with 1 lb. dry pulverized white sugar. Put in a single drop of oil of lemon peel to flavor it and mix well; preserve in bottles for future use. In place of citric acid you may take tartaric acid.

2.—Tartaric acid, 1 oz.: castor sugar, 4 oz.; essence of lemon, fine 1 dram. Mix these ingredients well together, spread them on a plate, stir and turn over repeatedly until thoroughly dry. Divide into 20 equal portions, warp them carefully in separate papers and store for use in an air-tight tin. Each portion is sufficient for 1 glass of lemonade.

Seltzer.—Take the juice of 1 lemon with ½ glass of chipped ice, 1 oz. of lemon syrup made from the fruit and 1 teaspoonful powdered sugar. Draw on about 2 oz. of soda and stir well until the sugar is dissolved. Strain into a tall mineral glass and fill with soda, using the fine stream to stir. Serve while foaming. If you have no freshly made lemon syrup cut 2 or 3 slices of the lemon rind into the glass when mixing. The powdered sugar must be used to give "life" to the drink.

Lime.

1.—Lime fruit syrup, ½ oz.; lemon syrup, ½ oz.; solution acid phosphate, 1 dram; shaved ice, 2 oz. Mix with soda, stir thoroughly, strain into 8-oz. glass, fill slowly with coarse stream and stir again.

2.—Pure lemon syrup, 1 oz.; lime juice, ½ oz. Pour over fine ice in mineral glass, fill up with soda and stir.

3.—Into a 13-oz. glass, tall and slender, draw 1½ oz. of grape juice, squeeze the juice of 1 lime and add 3 dashes of Angostura bitters, 2 dashes of phosphate and 1½ oz. of simple syrup. Fill the glass one-third full of fine ice and the balance with carbonated water. Mix and decorate.

Cordial.—Boric acid, ¼ oz.; citric acid, 2 oz.; sugar, 3 lb.; water, 2 pt. Dissolve by heat. When cold add lime juice, 30 oz.; tincture of lemon, 2 oz.; water to 1 gal. Mix and color with caramel.

Pepsin.—Pure Pepsin, 260 gr.; distilled water, 3 oz.; glycerine, 3 oz.; alcohol, 1½ oz.; purified talcum, ½ oz.; lime juice enough to make 1 pt. Dissolve the pepsin in the water mixed with 8 fl.oz. of lime juice, add the glycerine and alcohol and then the remainder of the lime juice; incorporate the talcum and set aside for several days, agitating occasionally, and then filter, adding through the filter enough lime juice to make 1 pt. of finished product. To make a syrup of this add enough simple syrup to make 3 qt. and mix thoroughly.

Vichy.—Into an 8-oz. glass of vichy shake a few dashes of lime juice from your spirit bottle, or squeeze into it the fresh juice of half a lime.

Orange.

1.—The juice of 15 oranges, the rind of 3 oranges, 2 qt. of water, ¾ lb. of loaf sugar, crushed ice. Remove the peel of 3 oranges as thinly as possible, add it and the sugar to 1 pt. of water, then simmer gently for 20 minutes. Strain the orange juice into a glass jug, and add the remaining 3 pt. of water. As soon as the syrup is quite cold strain it into the jug, add a handful of crushed ice and serve at once.

2.—Slice crosswise 4 oranges and 1 lemon; put them into an earthen jug with 4 oz. of lump sugar; pour upon these 1 qt. of boiling water and allow to stand covered for 1 hour. Decant and ice.

3.—Simple syrup, ½ fl.oz.; tincture of

orange peel, ½ dr.; citric acid, 1 scruple; fill the bottle with aerated water.

4.—Lemon juice, 1 oz.; orange juice, 2 oz.; granulated sugar, 4 teaspoonfuls; shaved ice, ½ glass. Mix in some soda by stirring, strain into 12-oz. glass and fill with coarse stream of carbonated water.

Effervescing, or Aerated, or Sherbet.—a.—Mix 1 lb. of syrup of orange peel, 1 gal. water and 1 oz. citric acid, charge strongly with carbonic-acid gas with a machine.

b.—Syrup orange juice, ¾ oz.; aerated water, ½ pt.

c.—Mix 1 lb. syrup of orange peel, 1 gal. water and 1 oz. citric acid and charge it strongly with carbonic-acid gas with a machine.

d.—Syrup of orange juice, ¾ fl.oz.; aerated water, ½ pt

Raspberry.

1.—Add to 1 qt. fresh ripe berries the juice of 1 lemon and 1 tart orange. Bruise with a wooden spoon, add 1 pt. of water and let it stand an hour; meanwhile boil ¾ lb. of sugar with 1 qt. of boiling water and let this become cold. Rub the fruit through a fine sieve; add to the syrup and serve with shaved ice in glasses or simply chilled. Currants may be used in the same way.

2.—Raspberry vinegar, 2 oz.; sugar, 1 tablespoonful. Fill 8-oz. glass with coarse stream.

MALT BEVERAGES

Cherry.—Malt extract, 8 oz.; tincture celery seed, 2 dr.; orange syrup, 4 oz.; comp. tincture gentian, 1 dr.; lemon syrup, to make 2 pt. Mix and serve 1 oz. in an 8-oz. mineral glass, with or without phosphate.

Coca.—1.—Fluid extract coca, 1 oz.; alcohol, 1 oz.; extract malt, to make 4 pt.

2.—Extract malt, 4 oz.; coca cordial, 1 oz.; cherry syrup, 10 oz. Mix. Trim with fresh cherry.

3.—Extract malt, 4 oz.; coca cordial, 1 oz.; syrup phosphoric acid, ½ dr.; lemon syrup, 10 oz. Mix. Trim with sliced lemon.

4.—Draw 1 oz. of coca wine syrup into an 8-oz. glass, add 1 oz. of malt extract, a couple of dashes of phosphate and fill with soda. If desired, the phosphate may be omitted.

C—K—.—1.—Malt extract, 8 oz.; vanilla extract, 1 dr.; orange syrup, 2 oz.; cinnamon syrup, 2 oz.; Coca Cola, 2 oz.; simple syrup, 18 oz. This can be served with foam in 12-oz. or 8-oz. glass. Coca Cola is a proprietary article.

2.—Extract of malt, 2 lb.; kola wine syrup, 3 pt.; coca wine syrup, 1 pt.; cinchona wine syrup, 1 pt.; pure orange wine, 1 pt.; spirit of rose, ¼ fl.oz.; acid solution of phosphate, 8 fl.oz. The kola wine syrup is made by adding 2 pt. of kola wine to 3 pt. of simple syrup. The coca wine syrup is made by adding 2 pt of coca wine to 3 pt. of simple syrup.

3.—Malt extract, 8 oz.; Coca Cola syrup, 24 oz. Serve still in 8-oz. glass with or without phosphate. Coca Cola syrup for the above is composed as follows: Fluid extract of kola, 2 oz.; elixir of calisaya, 3 oz.; wine of coca, 6 oz.; extract of vanilla, 4 dr.; fruit acid, 1 oz.; syrup enough to make 1 gal. See page 206.

Fruit.—Malt extract, 12 oz.; raspberry syrup, 2 oz.; cinnamon syrup, 2 oz.; rose syrup, 2 oz.; orange flower water, 2 dr.; orange syrup, 12 oz. Serve with or without phosphate.

Iron Malt.—Extract of malt, 8 oz.; elixir of beef, iron and wine, 8 oz.; pineapple syrup, 8 oz.; simple syrup, 1 pt. Mix and serve still in an 8-oz. mineral glass.

Kola.—1.—Malt extract, 6 oz.; pineapple juice, 4 dr.; fluid extract kola, 2 dr.; extract vanilla, 2 dr.; fruit acid, 2 dr.; lemon syrup, 25 oz. May be served still or foamed, with or without phosphate.

2.—Make same as the cocoa malt, using any tonic syrup containing the fluid extract of kola nuts.

Malt Wine Cordial.—Malt wine, 8 oz.; orange syrup, 24 oz. Serve solid in 8-oz. glass.

MALTED MILK

How to Prepare Malted Milk.

The following method is recommended by the editor of *Modern Medicine:* To a pint of milk add 1 tablespoonful of malt. The milk may be heated to a temperature of 60° F. After that it should be brought to a boiling point and boiled for 20 to 30 minutes. This will check the further action of the malt. Milk thus treated does not form large, hard curds in the stomach and agrees perfectly with many persons who cannot digest milk in its ordinary form. This method of peptonizing milk is much preferable to the old way, in which various preparations of pancreatin were employed; these animal substances not infrequently imparted a very unpleasant flavor and odor and sometimes poisonous substances. Prepared in the way above described it is always fresh, besides being cheap and convenient.

1.—Put a tablespoonful in a shaker, fill half full with cold water, shake thoroughly, strain into a 12-oz. glass and fill with fine stream. Cracked ice may be used if desired.

2.—Malted milk, 1 tablespoonful; pepper and salt or sugar; water, 8 oz.

3.—Vanilla syrup, 2 teaspoonfuls; uncharged water or milk, 2 tablespoonfuls; cream, plain, 2 tablespoonfuls; cracked ice, sufficient; malted milk, 1 tablespoonful. Put in a shaker, shake thoroughly, strain and fill glass with plain soda, fine stream.

4.—Malted milk, 2 oz.; plain cream, 1 oz.; plain water, ice cold, to fill 10-oz. glass. Shake well and top off with whipped cream and grated nutmeg if desired, or serve plain. Cracked ice may be used, but the cold water makes a better, creamier drink.

Cocoa.—Chocolate syrup, 1 oz.; plain cream, 1 oz.; shaved ice, sufficient; plain water, 2 oz.; malted milk, 2 tablespoonfuls. Put in a shaker, shake thoroughly, strain and fill glass with fine stream.

Coffee Syrup.—Prepare a syrup of 8 oz. malted milk, 16 oz. sugar, 2½ oz. coffee extract, 24 oz. water. Dissolve malted milk and coffee in water. Strain, cool, add coffee extract and color with caramel.

Coffee Punch.—Malted milk coffee syrup, 2 oz.; shaved ice, ½ glass; milk, ½ oz. Fill 12-oz. glass with soda and sprinkle on nutmeg.

Egg.—1.—Vanilla syrup, 1 oz.; plain cream; 1 oz.; 1 egg; shaved ice, sufficient; plain water, 2 oz.; malted milk, 2 tablespoonfuls. Put in shaker, shake thoroughly, strain and fill glass with fine stream and sprinkle with nutmeg.

2.—Put 1 egg in mixing glass; vanilla syrup, 1 to 2 oz.; plain cream, 3 oz.; malted milk, 2½ teaspoonfuls. Shake well with ice. Use fine stream only and serve in bell glass.

3.—Coffee or chocolate syrup, 1½ oz.; 1 egg; sweet cream, 1 oz.; malted milk 2 teaspoonfuls; shaved ice. Shake thoroughly and fill with soda, using fine stream mostly.

4.—Plain syrup, ½ oz.; sherry wine, 1 tablespoonful; 1 egg; cream, ½ oz.; sufficient ice; malted milk, 1 tablespoonful. Put in shaker, shake thoroughly, fill glass with heavy and fine stream; strain into 12-oz. thin glass.

5.—One egg; malted milk, 1 teaspoonful; clam bouillon, ½ oz.; hock syrup, 1 oz.; cracked ice, ¼ tumblerful. Shake well, strain and add 1 dash of liquid phosphate, filling with plain soda. Pour from shaker to tumbler and serve with nutmeg and straw.

Hot Malted Milk.—Malted milk, 1 dessertspoonful; hot soda, 1 cupful. Season with pepper and salt.

Ice Cream.—Vanilla syrup, 2 teaspoonfuls; uncharged water or milk, 4 oz. or 1-3 glass; ice cream, 2 tablespoonfuls; Horlick's malted milk, 1 tablespoonful. Put in a shaker, shake thoroughly, strain and fill glass with plain soda, fine stream.

Milk Orange.—Orange syrup, 2 teaspoonfuls; uncharged water or milk, 4 oz. or 1-3 glass; cracked ice, sufficient; eggs, 1 or 2; Horlick's malted milk, 1 tablespoonful. Put in shaker, shake thoroughly, strain and fill glass with plain soda.

Syrup.—Malted milk, 8 oz.; hot water, 8 oz.; simple syrup, 4 pt.

MEAD

Mead is an old-fashioned beverage, but a very pleasant one, if care is taken in making it. It is generally made overstrong, too much honey being used to the proportion of water.

1.—On 30 lb. honey (clarified) pour 13 gal. soft water, boiling hot. Clarify with the whites of eggs, well beaten; boil again, remove all scum as it rises, add 1 oz. of best hops and boil for 10 minutes, then pour the liquor into a tub to cool, spreading a slice of toast on both sides with yeast, and putting it into the tub when the liquor is nearly cold. The tub should stand in a warm room. When fermentation has thoroughly begun; pour the mixture into a cask, and as it works off, fill up the cask, keeping back some of the liquor for this purpose. Bung down closely when fermentation has ceased, leaving a peg hole, which can be closed up in a few days. Let it remain a year in the cask before bottling off.

2.—Water, 10 gal.; strained honey, 2 gal.; burned white ginger, 3 oz. troy; lemons, sliced, 2. Mix all together and boil for half an hour, carefully skimming all the time. Five minutes after the boiling commences add 2 oz. troy of hops; when partially cold put it into a cask to work off. In about 3 weeks it will be fit to bottle.

3.—Cherry juice, 1 pt.; rose syrup, 4 oz.; cinnamon water syrup, 8 oz.; mead extract, 4 oz.; fruit acid, ½ oz. Mix thoroughly with 6 pt. of simple syrup.

4.—Mead extract, 8 oz.; Angostura bitters, 12 oz.; honey, ½ gal.; rock candy syrup, 1½ gal.; tartaric (or citric) acid, 1 oz.; water, 4 oz.

5.—Tonka beans, 2 dr.; mace, 2 dr.; cloves, 1 oz.; cinnamon, 1 oz.; ginger, 1 oz.; nutmeg, 1 oz.; pimento, ½ oz.; sassafras bark, 3 oz.; lemon gratings, 1 oz.; orange gratings, 1 oz. Bruise the drugs in a mortar or grind them very coarse and tie them loosely in a cheese cloth or muslin bag. Suspend them in 2 gal. of simple syrup and heat to 80° C. for a few hours, the longer the better providing the temperature is not too high. The sassafras and pimento should be boiled in 2½ pt. of water until it has boiled down to about 1½ pt. Filter and add 2 pt. of honey and then mix with the other syrup. Add syrup enough to make 2½ gal. and filter through a felt filter bag.

6.—*Coloring Mead.*—Mead syrups may all be colored with caramel; when served they should look like a dark root beer.

7.—*Extract.*—Sarsaparilla, 2 lb.; lignum vitae wood, 1 lb.; licorice root, 1 lb.; ginger root, 12 oz.; cinnamon bark, 12 oz.; coriander seed, 6 oz.; aniseed, 2 oz.; mace, 4 oz. Contuse or cut very finely and put up in 2 or 4 oz. packages.

8.—*Serving Mead.*—Into a 12-oz. glass draw 1½ to 2 oz. and fill within about an inch of the top with carbonated water. Mix by pouring and then foam by the use of a fine stream as in serving root beer.

PHOSPHATES

Phosphates for the soda fountain are a solution of acid phosphate with any of the fruit or flavored syrups, omitting the soda foam, as phosphates are served solid. To each gallon of flavored syrup 8 fl.oz. of acid phosphate is added.

Acid Phosuhates.—1.—Bone ash, 32 av.oz.; sulphuric acid, 24 av.oz.; water, sufficient to make 1 gal. Mix the bone ash with 2 pt. of water in a glass or earthenware or other container which is not acted upon by the acid; add the acid previously diluted with the remainder of the water and mix thoroughly. Set the mixture aside for 24 hours with occasional stirring, then transfer the same upon a strong muslin strainer and subject to pressure, avoiding contact with metals; add to the magma some water and let drain until 1 gal. of liquid has been obtained, then filter through paper.

2.—Phosphoric acid, 50 per cent., 64 parts; precipitated chalk, 12 parts; calcined magnesia, 1 part; potassium carbonate, 1 part; distilled water, 178 parts. Add the chalk to the acid gradually and then add the magnesia and stir well. Dissolve the potassium carbonate in 9 fl.oz. of the water, add the solution gradually to the acid liquor, and mix the remainder of the water, set aside for 1 or 2 hours and filter.

3.—Phosphoric acid, 8 oz.; potassium phosphate, 80 gr.; magnesium phosphate, 160 gr.; sodium phosphate, 80 gr.; calcium phosphate, 240 gr.; water, to make 8 pt.

Apricot.—Apricot syrup, 96 fl.oz.; peach syrup, 16 fl.oz.; orgeat syrup, 8 fl.oz.; solution acid phosphate, 8 fl.oz. Mix.

Calisaya.—Elixir of calisaya, 16 fl.oz.; solution of acid phosphate, 8 fl.oz.; orange syrup, sufficient to make 1 gal. Mix.

Celery.—1.—Celery essence (4 oz. to pint), 16 fl.oz.; solution acid phosphate, 8 fl.oz.; lemon syrup, sufficient to make 1 gal. Mix.

2.—Fluid extract of celery seed, 4 fl.oz.; solution acid phosphate, 8 fl.oz.; orange syrup, 32 fl.oz.; lemon syrup, sufficient to make 1 gal. Add the fluid extract of celery to the acid solution, let stand for several hours, pass through a wetted paper filter and mix with the syrups

3.—Tincture celery seed, 1 oz.; pineapple juice, 8 oz.; juice of 1 lemon; simple syrup, q. s. 4 pt.

Cherry.—1.—Solution of acid phosphate, 8 fl.oz.; cherry juice, red, 16 fl.oz.; raspberry juice, 8 fl.oz.; syrup, sufficient to make 1 gal. Mix.

2.—Solution of acid phosphate, 8 fl.oz.; wild cherry syrup, 32 fl.oz.; orange syrup, sufficient to make 1 gal. Mix.

3.—Wild Cherry.—a.—Solution of acid phosphate, 8 fl.oz.; cherry juice, German black, 8 fl.oz.; syrup of wild cherry, U. S. P. 16 fl.oz.; oil of bitter almond, 10 drops; syrup, sufficient to make 1 gal. Mix.

b.—Essence bitter almond, 10 dr.; acid phosphate, 12 oz.; fruit acid, 1 oz.; simple syrup, 3 qt.; caramel coloring, 1 dr.; cochineal coloring, ¼ dr.

c.—Oil bitter almond, 6 drops; acid phosphate, 2½ oz.; caramel, 6 dr.; rock candy syrup, enough to make 2 pt. Dissolve the oil of bitter almond in ¼ oz. of alcohol and mix with the other ingredients.

Chocolate.—Chocolate syrup, 1 oz., and cracked ice; add a little solution acid phosphate and fill with plain soda.

Coca.—Fluid extract of coca, 1 fl.oz.; solution of acid phosphate, 8 fl.oz.; vanilla syrup, sufficient to make 1 gal. Add the fluid extract of coca to the acid solution, let stand for several hours, pass through a wetted paper filter and mix with syrup.

Cranberry.—Cranberry syrup, 1 fl.oz; solution acid phosphate, a teaspoonful; plain soda, 7 oz. Mix and serve.

Egg.—1.—Draw into a thin 9-oz. tumbler 2 oz. of Maltese (red) orange syrup and add an egg, a few squirts of acid phosphate and a small piece of ice; shake well, fill shaker with soda water—using the large stream only—and strain.

2.—Syrup lemon, ½ oz.; 1 fresh egg; solution acid phosphate, 1 dr. Serve the phosphate from an essence bottle.

Frozen Phosphate.—Fill 8 or 9-oz. glass with finely shaved ice, add 3 dashes of solution of acid phosphate and nearly cover the ice with the desired syrup; serve with a spoon.

Fruit.—1.—Solution of acid phosphate, 8 fl.oz.; cherry syrup, 16 fl.oz.; pineapple syrup, 16 fl.oz.; raspbeery syrup, 16 fl.oz.; strawberry syrup, 16 fl.oz.; orange syrup, 16 fl.oz.; lemon syrup, sufficient to make 1 gal. Mix.

2.—Into a mineral water (7 or 8 oz.) glass draw 1 to 1½ oz. of the specified fruit syrup, add 1 dr. dilute phosphoric acid or phosphate solution; in another glass draw plain carbonic-acid water and pour into the first tumbler or glass to fill it, avoiding foam. This is preferable to making a long line of varying fruit phosphate syrups.

Grape.—1.—Solution of acid phosphate, 8 fl.oz.; grape juice, 16 fl.oz.; raspberry syrup, sufficient to make 1 gal.

2.—Grape juice, 1 oz.; orange syrup, 2 oz.; acid phosphate, 20 drops. Serve in a mineral glass.

Ginger.—1.—Solut. ess. ginger, 2 oz.; solut, ess. lemon, ½ oz.; solut. acid phosphate, 8 oz.; syrup, 8 pt.

2.—Solution of acid phosphate, 8 fl.oz.; tincture of ginger, 4 fl.oz; lemon syrup, sufficient to make 1 gal. Add the tincture of ginger to the acid solution, let stand for several hours and pass through a wetted paper filter and mix with the lemon syrup.

Kola.—1.—Solution of acid phosphate, 8 fl.oz.; fluid extract of kola, 4 fl.oz.; vanilla syrup, sufficient to make 1 gal. Add the fluid extract of kola to the acid solution, let stand several hours, pass through a wetted paper filter and mix with the vanilla syrup.

2.—Fluid extract of kola, 1 oz.; soluble essence of lemon, ½ oz.; compound tinc. of vanillin, 6 dr.; acid solution of phosphate, 2 oz.; rock candy syrup, to 32 oz.

Lemon.—1.—Lemon syrup, 7 pt.; pineapple syrup, 1 pt.; solut. acid phosphate, 8 fl.oz.

2.—Solution of acid phosphate, 8 fl.oz.;

lemon syrup, sufficient to make 1 gal. Mix.

3.—Ext. lemon, 1 fl.oz.; tinc. celery seed, 2 fl.oz.; pineapple juice, 8 fl.oz.; acid phosphate, 6 fl.oz.; syrup, to make 8 pt.

Mint.—Spirit of spearmint, 2 fl.dr.; solution of acid phosphate, 2 fl.dr.; simple syrup, enough to make 32 fl.oz. The syrup may be colored a pale green by adding a tincture made by macerating spinach in alcohol.

Orange.—1.—Solution of acid phosphate , 8 fl.oz.; orange syrup, sufficient to make 1 gal. Mix. Blood orange phosphate syrup may be prepared in the same manner by using blood orange syrup.

2.—Essence of orange (1-8), 1 to 4 fl.dr.; solution acid phosphate, 12 oz; solution citric acid (50 per cent), 1 oz.; caramel coloring, 1 dr.; cochineal coloring, 15 m. The quantities given are sufficient to flavor 1 gal. of syrup.

3.—Blood Orange.—Raspberry juice, 6 oz.; extract orange, 1½ oz.; fruit orange, ¾ oz.; syrup, 1 gal.; red coloring, enough. The addition of raspberry juice improves the orange flavor. The acid phosphate (1 dr.) is added when the drink is served.

4.—Cider.—A so-called orange cider phosphate may be made by adding to each gallon of finished product from the following formula about 4 oz. of dilute phosphoric acid or an equal quantity of solution of acid phosphates of the National Formulary.

Express the juice from sweet oranges, add water equal to the volume of juice obtained and macerate the expressed oranges with the juice and water for about 12 hours. For each gal. of juice add 1 lb. of granulated sugar, grape sugar or glucose, put the whole into a suitable vessel, covering to exclude the dust, place in a warm location until fermentation is completed, draw off the clear liquid and preserve in well-stoppered stout bottles in a cool place.

Pepsin.—1.—Essence of pepsin, 8 oz.; tincture of celery seed, 1 oz.; lemon syrup, enough to make 4 pt.

2.—Solution of pepsin, N. F., 8 oz.; raspberry syrup, 16 oz.; solution of acid phosphate, 4 oz.; syrup, enough to make 4 pt. Lime juice, orange, grape and other phosphates are similarly made.

Pineapple.—1.—Take a large glass with the fruit and shaved ice about half full, add a little phosphate and draw on soda, stirring with the fine stream. It may be served as it is with straws or strain into a thin mineral glass.

2.—Solution of acid phosphate, 8 fl.oz.; orange syrup, 16 fl.oz.; vanilla syrup, 8 fl.oz.; pineapple syrup, sufficient to make 1 gal. Mix.

Raspberry.—1.—Raspberry syrup, 1 gal.; solut. acid phosphate, 8 oz.; solut. ess. rose, ¼ oz.

Strawberry.—1.—Strawberry syrup, 7 pt.; vanilla syrup, 8 oz.; pineapple syrup, 8 oz.; solut. acid phosphate, 8 oz.

2.—Solution of acid phosphate, 8 fl.oz.; pineapple syrup, 16 fl.oz.; strawberry syrup, sufficient to make 1 gal. Mix.

3.—Wild Strawberry.—a.—Strawberry syrup (from juice), 6 pt.; lemon syrup, 1 pt.; infusion wild cherry (fresh), 1 pt.; tartaric acid, 2½ dr. Dissolve the acid in the infusion and add, with the lemon syrup, to the syrup of strawberry. Serve without foam in thin mineral glasses.

b.—Strawberry syrup, 6 pt.; lemon syrup, 1 pt.; fresh infusion wild cherry, 1 pt.; tartaric acid, 2½ dr. Dissolve the acid in the infusion and add with the lemon syrup to the syrup of strawberry. Serve without foam in thin mineral glasses.

Tangerine.—Tangerine syrup, 7 pt.; pineapple syrup, 8 fl.oz.; muscatel wine, 8 fl.oz.; solut. acid phosphate, 8 fl.oz.

PUNCHES

1.—Into a 12-oz. glass draw 1½ oz. of simple syrup. Into this squeeze the juice of 1 lemon and 1 orange. Fill one-third full of lemon ice and balance with carbonated water.

2.—Into a 12-oz. glass draw 1½ oz. of tonic syrup and break into it an egg. Add the juice of a small orange, an ounce of grape juice and a little fine shaved ice. Shake thoroughly and fill with carbonated water, the same as when making an egg phosphate. Strain into a clean glass and serve.

3.—Into a 14-oz. glass draw 2 oz. of pineapple syrup, 1 oz. of grape juice and ½ oz. of claret wine. Into this squeeze the juice of ½ of an orange and fill 1-3 full of fine ice. Fill with soda and mix with spoon, decorate with slice of an orange and 2 cherries on picks. Serve with straws.

4.—Into a 12-oz. glass draw ½ oz. of raspberry syrup, 1 oz. of lemon syrup and 1 oz. of claret wine (the wine can be replaced by grape juice). Into this squeeze the juice of ½ a lemon, fill glass 1-3 full of fine ice and the balance with carnboated water. Mix by stirring, decorate with a slice of lemon and serve with straws.

5.—Yolk of 1 egg; grape juice, 1 oz.; lemon juice, 2 dr.; powdered sugar, 2 teaspoonfuls. Mix well together; add the hot water, top off with whipped cream and serve with nutmeg and cinnamon.

6.—Into a 12-oz. glass draw ¾ oz. of raspberry, ¾ oz. of orange syrup and 1 oz. of grape juice. Into this squeeze the juice of ½ a lemon and fill 1-3 full of ice, then fill with soda water and mix. Into this put 2 cherries and 2 pineapple cubes on toothpicks. Serve with straws.

Cider.—Chip the thin yellow rind from a lemon, bruise it slightly and add a cup of sherry wine. Let it stand an hour. Squeeze the juice of 1 lemon and 2 oranges over 1½ cups of granulated sugar, add a quart of cider that has a slight "nip," then pour over the lemon rind and sherry. Turn into a freezer and freeze same as water ice. Serve in glasses and over each pour a teaspoonful of brandy.

Claret.—Claret syrup, ½ oz.; orange, 1 slice; lemon, 1 slice; shaved ice, ¼ glass. Fill 12-oz. glass with coarse stream, stir, decorate with fruit and serve with straws.

Coffee.—Malted milk coffee syrup, 2 oz.; shaved ice, 2-3 glass; milk, 4 oz. Fill with plain soda, stir rapidly, serve spices to please.

Fruit.—1.—The Pure Fruit Punches without the addition of any kind of liquor, are made the same as any water ice, only keep the composition at 15° instead of 20°, and freeze only about half, in order to have the punch in a semi-liquid state. You may add 2 to 3 whites of eggs for every 12 quarts of water ice.

2.—Into a 14-oz. glass draw 1 oz. of pineapple syrup, ½ oz. of raspberry syrup and ½ oz. of lemon syrup. Into this squeeze the juice of ½ a small grape fruit. Fill the glass 1-3 full of orange ice and the balance with carbonated water, mix and decorate with a slice of orange.

3.—In 3 pt. of water dissolve 1 lb. of sugar. Run through a felt filter bag and add ½ pt. of orange juice, ½ pt. of lemon juice, 4 oz. of either strawberry or raspberry concentrated syrup. Place in a punch bowl and ice. Add ½ pt. of fresh cut pineapple cubes and ¼ pt. of preserved fruits.

4.—Strawberry syrup, 2½ pt.; orange syrup, 2½ pt.; pineapple syrup, 2½ pt.; lemon juice, ½ pt. Mix well and strain. To 1½ oz. of this syrup add ¼ tumblerful of shaved ice, 3 strawberries, 1 slice of pineapple, 1 slice of orange and sufficient carbonated water to fill the glass.

5.—Strawberry syrup, orange syrup, pineapple syrup, raspberry syrup, of each 1 pt.; grape juice, 4 pt. Serve in mineral glass same as any syrup.

6.—Lemon syrup, 1 pt.; strawberry syrup, 1 pt.; orange syrup, 1 pt.; acid phosphate, ½ oz.; 1 sliced orange. Serve 1½ oz. in mineral water, add shaved ice. Fill glass with solid soda, top with maraschino cherries and serve with a straw.

7.—Into a 14-oz. glass draw ¾ oz. each of strawberry, orange and raspberry syrup. Into this squeeze the juice of ½ lemon. Fill 1-3 full of fine ice, add a spoonful of fruit salad and fill with carbonated water and mix.

8.—Lemons, 1 doz.; oranges, ½ doz.; grated pineapple, 1-3; sugar to taste; strain through sieve; add water enough to make 1 gal. Garnish with strawberries, raspberries or maraschino cherries.

Grape.—1.—Grape juice, 2 oz.; sweet cream, 2 oz.; ice cream, 1 spoonful; bitters, 3 dashes. Shake thoroughly, strain, pour back into shaker and add soda to fill glass. Throw as for mixing egg drinks. Nutmeg may be added if desired.

2.—In an 8-oz. stem glass place 1 oz. of orange syrup, add ½ oz. of grape juice, a slice of lemon and cracked ice. Fill with soda and serve.

Mint.—Put into a punch bowl 1 cup of granulated sugar and the juice of 6 lemons. Peel 3 lemons and slice them very thin. When the sugar has dissolved add the sliced lemon, 1 doz. sprays of mint and an abundance of crushed ice. Now stir in 3 bottles of imported ginger ale and enough green vegetable coloring matter to make the punch of the desired green shade.

Orange.—Grate the yellow rind from 2 oranges and add 1 lb. of white sugar and 1 pt. of water. Stir together until the sugar is entirely dissolved and boil 5 minutes after it comes to a boil. When cold add the juice of 1 lemon and the juice of 4 oranges. Pour over cracked ice and add about 1 qt. of clear water.

Pineapple.—1.—Cut a peeled pineapple into small pieces and cover with a cup of sugar; stand until syrup is drawn out; then strain, squeezing hard, and set in ice. Serve in tiny glasses of crushed ice, adding a dash of maraschino to each glass as you pour in the pineapple syrup.

2.—To the juice of 6 lemons and 6 oranges add sugar to taste, with sliced pineapple and a few bits of lemon peel, 2 qt. of water and chopped ice to cool.

Pistachio. — 1. — Pistachio syrup, 1½ oz.; cream, 1 oz.; Jamaica rum, 3 dashes; crushed ice. Fill with soda, shake well, grate a little nutmeg on the top.

2.—Pistachio syrup, ½ oz.; lime juice

syrup, ½ oz.; raspberry syrup, ½ oz.; ice cream, 3 oz.; ice, ½ glass. Shake, strain, toss and serve

Raspberry.—Raspberry syrup, 1½ oz.; juice of ½ lemon; blackberry brandy, ½ oz. Fill 10-oz. glass half full shaved ice and fill with soda, adding small piece of lemon peel. Straws.

2.—Raspbery wine (unfermented), 2 oz.; lemon juice, 1 dash, drawn in 8-oz. mineral glass half full of shaved ice. Fill glass with plain soda, squeeze piece of lemon or orange rind into the punch and serve with cut straws.

Strawberry.—Crush 1 qt. of ripe strawberries with ½ pt. of raspberries and strain the juice through a hair sieve. Make a syrup with 2 large cupfuls of sugar and 1½ cups of water. Mix with the juice and syrup a large glass of sweet port wine and keep on ice for several hours. Serve in small glasses with macaroons or lady fingers.

Tutti Frutti Punch.—Boil for 5 minutes 1 qt. of water and 1 lb. of sugar. Add grated rinds of 2 lemons and 4 oranges and continue boiling for 5 minutes. Strain and add 1 qt. cold water. Extract the juice from the lemons and oranges, strain and mix with 1 lb. of seeded malaga grapes, 2 sliced tangerine oranges, 4 slices pineapple, contents of 1 pt. bottle of maraschino cherries. Serve from a punch bowl in which a cube of ice has been placed.

SUNDAES.

1.—Ladle of ice cream; circle center with 6 peppermint wafers on toothpicks, lay on top cube of pineapple, small piece of sliced orange and a whole cherry.

2.—Ginger cordial syrup, mix with ginger fruit, pour over vanilla ice cream, sprinkle with cinnamon. Serve in sundae cup and top off with maraschino cherries.

3.—Place 5 macaroons around edge of saucer. Place a cone of vanilla ice cream (measured out with a 12-to-the-quart ice disher) in the center of the saucer. Over the ice cream pour ½ ladleful of pineapple fruit and 1 oz. of maple syrup. Top off with a small measure of maple sugar.

4.—In a 9-oz. stem glass place vanilla cream, 1 scoop; strawberry cream, 1 scoop; crushed pineapple, 1 oz.; crushed raspberries, 1 oz. Place a lady finger at each side in top of glass. Top with whipped cream and a cherry.

Cherry.—Turn a measure of ice cream in a saucer champagne glass, pour over this several maraschino cherries and 1 oz. of cherry phosphate syrup. Serve with a spoon. Can be improved by adding a little whipped cream.

Chocolate.—Strawberry syrup, 10 oz.; vanilla syrup, 10 oz.; raspberry syrup, 8 oz.; chocolate syrup, 4 oz. Pour a ladle of this sauce over plain ice cream.

Chop Suey for Sundaes.—1.—Seeded raisins, ½ lb.; shredded cocoanut, 2 oz.; green cherries, 4 oz.; red cherries, 4 oz.; sliced pineapple, 4 oz.; dates, 4 oz. Chop and mix; add maple and cherry syrup, equal parts, to thin enough to serve; 2 oz. port wine and 2 oz. sherry wine adds to the flavor.

2.—Half lb. of figs chopped into small pieces, ½ lb. of seeded dates cut up, 1 lb. of English walnuts broken, but not too fine. Add syrup enough to make 2 qt., color dark red. Fill a sundae glass two-thirds full of ice cream, pour over it a large ladle of chop suey, a little whipped cream and a cherry on top.

Dates, Stuffed.—Use souffle dish; put 5 stuffed dates around ice cream; flavor with maraschino juice; top with whipped cream and cherries.

Nut Sundae.—1.—Ice cream; sliced orange, cut in diamond-shaped pieces; sliced pineapple, cut in triangular shape; English walnuts; maraschino cherries. The nuts and fruit are to be arranged artistically and no syrup used.

2.—In a saucer place a No. 8 cone of vanilla ice cream. Around the ice cream place a ring of marshmallows, above this a ring of 6 walnut halves. Add 2 red and 2 green or white cherries and over all pour 1 oz. of grape juice. Serve nabisco wafers.

3.—Small spoonful ice cream in sundae cup, then pour over some grated walnuts, then some more ice cream, then top off with sliced bananas and whipped cream.

4.—Ladle of ice cream; top with usual amount of fruits mixed, raspberries, sliced peaches and claret syrup; a teaspoonful of nut sundae; dress with whipped cream if desired, fancy whole cherries and cubed pineapple.

5.—Chop 1 lb. of mixed nuts and add 10 oz. of crushed strawberry and 10 oz. of crushed pineapple sauce. Pour over plain ice cream.

6.—Into a sundae cup turn a cone-shaped measure of ice cream, over this pour a ladleful of walnut bisque, or walnut flakes, made according to directions on package, or sprinkle broken nuts over the top of the cream and pour on it an ounce of maple syrup. This can also be served topped with whipped cream and a cherry.

Pineapple.—The use of pineapple in

larger pieces, rather than the fine crushed, is recommended, as it makes a better appearance and it is nicer to eat with ice cream. The pineapple as it comes from the jars should be diluted with 2 parts of plain syrup in bowl on counter. Turn a cone-shaped measure of ice cream into sundae glass. Over this pour a ladleful of the fruit from the bowl and serve with a spoon.

Strawberry.—For this purpose it is better to use the whole fruit rather than the crushed strawberry. The whole strawberries as they come from the jars should be diluted with 2 parts plain syrup in bowl on counter. Turn a cone-shaped measure of ice cream into a sundae glass, over this pour a ladleful of fruit from the bowl and serve with a spoon.

Tutti Frutti.—Mix the following in a porcelain container: Crushed pineapple, ½ pt.; crushed strawberry, ½ pt.; crushed cherries, ½ pt.; crushed peach, ½ pt.; crushed blackberry, ½ pt.; prune juice, ½ pt., and a sufficient amount of simple syrup to give it the desired working consistency. Serve same as all sundaes.

Watermelon.—Take a long glass dish and lay on it a neat slice of the heart of a ripe watermelon, avoiding the seeds. On one end of the dish put a small ladleful of pineapple water ice, at the other end place a similar quantity of orange water ice. Pour over all a little strawberry syrup and put a maraschino cherry on the water ice at each end of the dish.

HOT BEVERAGES

Beef.

1.—Add 1 oz. of sweet cream to a cup of beef bouillon and top with whipped cream and you have a delicious drink.

2.—About 5 gr. crystal pepsin, ½ oz. boiling water. Dissolve, then add 1 teaspoonful beef bouillon, 1 cupful hot soda. Serve with pepper and salt.

3.—First make an extract by taking 6 oz. extract of beef, 16 oz. hot water, 5 dr. tincture of black pepper. Dissolve the beef extract in the hot water and add the tincture of black pepper. To make the tincture of black pepper take 2 oz. of whole black pepper, crush it, add 10 oz. alcohol. Steep and filter. To dispense, take 1 oz. of the beef extract, dash of cream, dash of salt and dash of celery salt. Fill up with hot water, stirring with spoon while filling.

4.—Beef jelly, 8 oz.; hot water, 1 pt.; extract of celery, 1 dr.; caramel 1 dr. Dissolve the beef jelly in the hot water and add the celery and caramel. Use a shaker top in the bottle, as there is likely to be a sediment which necessitates shaking. In a 6 or 7-oz. cup place about 2 teaspoonfuls of this extract, draw on a sufficiency of hot water, add salt to suit the taste and stir with a spoon.

Calisaya Tonic.

Fluid extract cinchona, 1 oz.; lemon syrup, 1 oz.; lemon juice, 1 oz.; hot water, 7 oz.

Checkerberry.

Draw ½ oz. of wintergreen spray and 1 oz. of red orange syrup into a mug and fill with hot water. Top with whipped cream. It may also be served by using 1 oz. wintergreen syrup and omitting the orange, but the first is to be preferred. The two syrups may be kept mixed and ready for dispensing.

Chicken Cream.

Two oz. of concentrated chicken and ½ oz. of sweet cream. Stir while adding hot water, after seasoning with a little spice.

Chocolate.

1.—Soluble powdered extract of chocolate, about 1 teaspoonful; hot soda, sufficient quantity to dissolve. Stir well and add loaf sugar, 4 cubes; prepared milk, I dessertspoonful; hot soda, 1 cupful; whipped cream, 1 tablespoonful.

2.—Chocolate syrup, 2 oz.; sweet cream, ½ oz.; filll with hot water, 6 oz. Serve with whipped cream. It is essential that the best grade of chocolate, such as Phillips', be used, and the flavor plenty strong to have the drink good.

3.—Add to 1 lb. of cocoa an equal amount of pulverized sugar; put a heaping teaspoonful of this powder in a mug and make into paste with a little water, then fill with hot soda, stirring briskly. Finish with ice cream or whipped cream.

4.—Chocolate syrup, 1 to 1½ oz.; 1 egg; cream, ½ oz.; hot water, enough to fill an 8-oz. mug. Prepare as with hot egg checkerberry.

5.—One egg; chocolate syrup, 1¼ oz.; sweet cream, 1 teaspoonful. Shake well, strain and add 1 cupful hot soda and 1 tablespoonful whipped cream.

6.—Place a full ½ oz. of cream chocolate in cup and fill with hot water, or, better, with hot milk and hot water mixed. Top with a spoonful of whipped cream.

7.—To be served from a hot soda apparatus having large cans: 2 qt. water, 2 lb. sugar, 1 qt. milk, 1 lb. powdered chocolate or 1 qt. cream chocolate. Put water into can over slow fire, let it come almost to a boil, add chocolate, milk and sugar, simmer for 5 minutes, pour into urn and keep it hot. Draw this chocolate into cup, add more sugar if desired and top with whipped cream.

Syrups.—1.—Chocolate, 8 oz.; granulated sugar, 4 oz.; boiling water, 28 oz.; chocolate syrup, enough to make 1 gal. Select a rich brand of chocolate. Grate or scrape fine and triturate with the sugar; then in a large warm mortar form a paste by trituration, gradually adding 18 oz. of boiling water; transfer to a porcelain vessel, heat slowly, stirring well; gradually add the remainder of the water, bring to a boil and boil for 5 or 6 minutes, stirring constantly; stir for some time after removing from the fire, then bring to a boil again and boil for 1 minute. By this means separation of cocoa butter is prevented, and the mixture does not require straining, but simple skimming. Add the syrup and the mixture may be flavored with vanilla extract or other flavors. Care must be exercised to make a smooth paste in the beginning and to avoid scorching at the last. A quantity of the chocolate may be kept on hand in a grated or scraped form, mixed with the proper amount of sugar. In serving use 1½ oz. of the syrup, add an ounce of cream, fill the mug with hot water, top with whipped cream and serve with crackers and a spoon.

2.—Good soluble cocoa, 3½ oz.; water, 2 pt.; granulated sugar, 40 oz.; vanilla extract, 4 dr. Heat the water to boiling, stir in the cocoa, gradually added; add the sugar; when latter is dissolved, strain and add the extract. Serve like the preceding.

3.—Powdered chocolate, 4 oz.; starch, ½ oz.; water, 2½ pt.; sugar, 2½ lb.; vanilla extract, 2 dr. Mix the chocolate and starch by trituration, mix intimately with part of the water, pour on the remainder of the water in a boiling condition, stir well and heat to boiling until the starch is cooked, stirring constantly; add the sugar, stir until dissolved, add the vanilla extract. Serve like preceding.

4.—Powdered cocoa, 3 lb.; water, ½ gal.; cream, 2 pt.; tincture of vanilla, 5 oz.; salt, 1 teaspoonful; simple syrup, enough to make 1 gal.

5.—Take 1½ lb. good sweet chocolate; grate fine; add 1 gal. milk while stirring; then beat a few minutes with egg beater to make it light and serve with whipped cream. This should be made in procelain-lined urn of even temperature and stir occasionally.

6.—Chocolate, 1 lb.; sugar, 6 oz.; boiling water, q. s. to make 1 gal. Grate or scrape the chocolate fine and triturate it with 2 oz. of the sugar (this may be done preliminarily, and in larger quantities, if necessary), then in a large warmed mortar form a paste under the pestle by the gradual addition of boiling water up to 40 fl.oz. Transfer to a porcelain dish, slowly heat, and stirring in well gradually add the remaining 4 oz. of sugar and 20 oz. of boiling water and bring the whole to the boiling point for 5 or 6 minutes, then remove and stir until ebullition ceases; return to fire and boil for 1 minute. By this means the cocao butter will not separate, and the product will not need straining, but skimming only. The attention is devoted to obtaining a smooth paste at the first step and in not overheating at the last.

7.—Chocolate, 3 cakes; gelatine, 1 small package; sugar, 9 lb.; hot water, 8 pt. Boil for 5 minutes and strain.

8.—Make the syrup by taking 4 oz. of light soluble cocoa; granulated sugar, 2 lb.; boiling hot water, 1 qt.; vanilla extract, 1 oz. Dissolve the cocoa in the hot water by stirring, then add the sugar and dissolve. Strain and when cold add the vanilla extract. To dispense, take 2 oz. of cocoa syrup and 1 oz. of cream. Turn on the hot water stream and stir while filling. Top with whipped cream.

Clams.

Clam juice, like beef tea, must always be served hot. It spoils very readily and must be kept on ice.

Clam juice may be served in the proportion of ½ to 1 oz. to an 8-oz. mug, filling the latter with hot water and serving with a spoon; also giving the patron celery salt, salt and pepper cellars and soda crackers. The clam juice is served more acceptably by adding an ounce of milk, better yet by using half water and half milk and still better by using all hot milk. A small amount of butter causes a marked improvement.

1.—Extract clam bouillon, about 2 tablespoonfuls; prepared milk, about 1 dessertspoonful; extract aromatic soup herbs, about 5 drops; extract celery and pepper, about 5 drops; hot soda, sufficient to fill cup.

2.—Blend. Use 1 oz. clam bouillon, ½ oz. tomato catsup or bouillon; fill cup with boiling water; season with salt, pepper and celery salt. A dash of sherry wine in clam bouillon makes a very fine clam punch.

3.—Extract clam bouillon, 2 tablespoonfuls; prepared milk, 1 dessertspoonful; extract aromatic herbs, 5 drops; extract white pepper, 5 drops; hot water, 1 cupful.

4.—Clam juice, ¼ oz.; beef extract, ¼ oz.; cream, 1 oz.; essence of celery, 4 dashes. Stir while adding hot water. Serve with spices.

5.—Clam juice, 2 oz.; lemon juice, 3 dashes; pepper and salt; water, 6 oz.

6.—Powdered Jamaica ginger, 1 teaspoonful; cream, 1 oz.; clam juice, 1 oz.; butter, 1 teaspoonful. Fill with hot water and season with celery salt.

7.—Clam juice, 1 oz.; tomato catsup, ¼ oz.; butter, ¼ oz.; dash of cream. Add hot water, stirring well, and serve with spices.

8.—Clam juice, 1 oz.; cream, ½ oz. Fill with hot soda, serve pepper and salt and celery salt.

9.—Clam juice, 2 dr.; beef extract, 1 dr.; cream, 1 oz.; essence of celery, 5 drops; hot water, to make 8 oz.

10.—Clam juice, ¼ oz.; beef extract, ¼ oz.; cream, 1 oz.; essence of celery, 4 dashes. Stir while adding hot soda. Serve with spices.

Coffee Extract.

1.—Select a good brand of coffee. It should be freshly ground each time you prepare your extract.

Moisten 1 lb. of fine ground, but not powdered, coffee with 4 oz. of cold water. Pack in a glass percolator. Add 1 pt. of boiling water, cover lightly and let stand for 1 hour; draw the cork and add sufficient boiling water to percolate 1 pt. Heat to the boiling point and allow it to pass through the coffee a couple of times. The strength should now be exhausted and you should have a pint of good coffee extract.

2.—Moisten 10 oz. of Mocha and Java or other good coffee with a little water. Pack in a glass percolator. Add 1 oz. of good French brandy with sufficient boiling water to percolate 30 oz. Cover tightly and let macerate for about an hour; then percolate.

3.—Moisten 20 oz. of good freshly roasted and ground coffee in a mixture of 2 oz. of glycerine and 4 oz. of cold water. Pack in a glass percolator. Add 2 oz. of glycerine and let stand for half an hour. Then add 14 oz. of boiling water and macerate for an hour. Then percolate until about a pint of good strong extract is obtained.

Some formulas call for dilute alcohol as a menstruum, but the above is preferable for hot soda purposes, since alcoholic extracts of coffee do not retain either the flavor or the aroma that the others do.

Burnt Coffee.—Allow 3 teaspoonfuls of good coffee to each ½ pt. of water. Sweeten it rather more than ordinarily, and strain it into small cups. Pour a little brandy into each over a spoon, set fire to it, and when the spirit is partly consumed, the flame should be blown out, and the coffee drunk immediately.

Roasting Coffee (a French recipe).—Add, before roasting, to every 3 lb. of coffee a piece of butter the size of a nut and a dessertspoonful of powdered sugar It is then roasted in the usual manner, and a tin in a slack oven, or a frying pan over the fire, will serve, with care. A rotating coffee roaster is of course much better. The addition of the butter and sugar develops the flavor and aroma of the berry; the butter employed must, of course, be of the very best quality and must be used only in very small quantities.

Serving.—1.—In using from ¼ to 1 oz. of extract, depending upon the strength of the extract and how strong a cup of coffee you desire, coffee may be served black or with half-hot milk or with a little sweet cream, allowing the customer to sweeten to taste.

2.—One egg; extract of Mocha, 1 dessertspoonful; sweet cream, 1 teaspoonful; syrup, 1 oz. Shake well, strain and add 1 cupful hot soda and 1 teaspoonful whipped cream.

Egg.

1.—Break fresh egg into mixing glass and shake well without ice. Pour into bouillon cup ½ oz. of beef tea extract. Draw hot water to fill cup and serve with 2 Graham crackers.

2.—One-half to 1 oz. liquid extract of beef, 1 egg, salt and pepper to season, hot water to fill an 8-oz. mug. Stir the extract, egg and seasoning together with a spoon to get well mixed; add the water, stirring briskly meanwhile. Then strain and serve. Or shake the egg and extract in a shaker, add the water and mix by pouring back and forth several times from shaker to mug.

3.—One egg, 1 oz. beef tea extract, ½ spoonful dairy butter Add several ounces hot soda and stir until the butter is dissolved. Fill up with hot soda.

4.—One egg, ½ oz. lime juice, 1 oz. lemon syrup, hot water enough to fill an 8-oz. glass. Prepare like hot egg checkerberry.

5.—Into a 10-oz. glass squeeze the juice of ½ of an orange, add 2 teaspoonfuls of powdered sugar and 1 egg. Shake thoroughly, strain into a clean glass and fill with hot water as directed.

6.—One oz. orangeade, 1 egg, ½ oz. cream, hot water to fill cup. Mix syrup, egg and cream in egg shaker; mix well and add the hot water.

7.—One egg; lemon juice, about 3 teaspoonfuls; soluble extract lemon, about 10 drops; confectioner's sugar, 3 large teaspoonfuls; prepared spice, small quantity; extract cognac, about 15 drops. Place these ingredients in a combination shaker and thoroughly shake; then strain through julep strainer into hot soda cup; to this add 2 large tablespoonfuls of whipped cream. Draw hot water into side of cup and stir bottom only.

8.—Break a fresh egg into a tumbler; add 3 dashes solution of acid phosphate. 1½ oz. of orange syrup, and shake thoroughly; then add hot water slowly into the shaker, stirring briskly meanwhile. Strain carefully into mug and serve. Checkerberry may be used instead of orange syrup.

Ginger.

1.—Loaf sugar, 4 cubes; soluble extract ginger ale, 10 drops; soluble extract lemon, 10 drops; fruit acid, 10 drops; 1 cupful hot soda.

2.—Use 1 oz. ginger punch to a cup and fill with hot water, adding small piece crystallized ginger.

Grape.

1.—Grape juice, 1 oz.; lemon syrup, ½ oz.; few drops sherry; hot water.

2.—Grape juice, hot, is preferred by many and is very beneficial. It may be taken before meals and often in the place of a regular meal. Heat in porcelain, agate or glass—never in tin—using one-third water if desired.

Kola.

Take 1 oz. kola punch in 8-oz. cup and draw 6 oz. hot water into another mug; pour a little alcohol over the hot water and ignite. Mix by pouring from one cup to the other a few times.

Lemonade.

1.—One of the original drinks so often made but served poorly is hot lemonade. There are numerous ways of preparing hot lemonade—and if you are as particular about making it good as you certainly are about your hot chocolate, there is no good reason why it won't profit you for your trouble. To make it from the juice of ½ a lemon: 1 teaspoonful powdered sugar; twist a small portion of lemon peel over the cup so as to get a flavor of the lemon; then fill cup with hot water and stir.

Lime.

1.—Lime juice, ½ oz.; lemon or ginger syrup, 1 oz.; hot water to fill. Lime juice with lemon or plain syrup or with sugar and hot water may be dispensed as "hot limeade."

2.—Lime juice, 1 oz.; strawberry juice, ½ oz.; sugar, 1 spoonful. Fill up with hot water, stirring well.

Malted Milk.

1.—Malted milk, 1 tablespoonful; pepper and salt or sugar; water, 8 oz.

2.—Malted milk (in powder), 2 spoonfuls; cream, 3 spoonfuls. Mix to a paste, fill with soda, serve celery salt.

3.—Two tablespoonfuls of malted milk, hot water to fill. While adding the water stir the mixture with a spoon so as to make it smooth. Season with salt and pepper, or with celery salt, and serve with soda crackers. Some dispensers add a couple teaspoonfuls of cream.

Egg.—Into a mixing glass draw 1½ oz. of chocolate syrup; into this break an egg and add 1 oz. of sweet cream and 2 teaspoonfuls of malted milk. Shake thoroughly and strain into a clean 10-oz. glass and fill with hot water.

Chocolate.—Pour 1 oz. of hot chocolate syrup into a mug and 2 teaspoonfuls of malted milk; reduce to a smooth paste and fill with hot milk or hot water and a little cream. Top with whipped cream if desired. This can be prepared by pouring finished cocoa over the powdered milk, but it is not the best way and it does not mix as well. Where powdered cocoa is used mix the two powders together dry, before adding your hot water. It is a good plan, if you use this method, to have the two already mixed for use. Use 1 part cocoa to 4 parts of malted milk and mix thoroughly.

Coffee.—Pour ½ oz. of coffee extract into a cup in which you have previously prepared a plain malted milk without salt. If you use finished coffee then put the powder in the mug and fill with hot coffee instead of hot water and add a little sweet cream, topping with whipped cream if you desire.

Mock Turtle Bouillon.

Make an extract of mock turtle by taking 2 oz. extract of beef, 2 oz. concentrated chicken, 8 oz. of clam juice, 3 pt.

of hot water, 1 oz. tincture black pepper, 3 dr. essence of celery, 1 dr. essence of orange peel. Mix and dissolve thoroughly. To dispense, take 2 oz. of the mock turtle extract and ½ oz. sweet cream. Stir while adding hot soda. Serve spices.

Orange.

Orange syrup, 1½ oz.; hot water to fill. Make the syrup stronger than for cold soda.

Oyster Broth.

To 1 oz. oyster juice add a teaspoonful of cream, a little butter and season to taste.

Phosphate.

Cherry.—Prepare a syrup with 12 oz. of cherry juice, 1½ lb. of sugar and 6 oz. water. Dissolve the sugar in the juice and water. In serving put 1½ oz. of the mixture in the mug and add 1 dr. of acid phosphate solution, filling the mug with hot water. If desired, the phosphate may be kept mixed with the syrup.

Pepsin.—Liquid pepsin, 1 teaspoonful; liquid phosphate, 2 dashes; lemon syrup, 1 oz.; hot water, 1 cupful.

Pistachio.

Pistachio or almond syrup, 1 oz.; cream syrup, 1 oz.; cream, ½ oz.; rum or bitters, a dash. Fill with hot soda, stirring well. Serve cinnamon.

Raspberryade.

Raspberry vinegar syrup, ½ oz.; raspberry juice, ½ oz.; lime juice, ½ oz. Add hot water, stirring well.

Sundaes.

Cherry.—Over pineapple ice cream pour a ladleful of hot cherry syrup.

Chocolate.—Rich hot chocolate syrup poured over a ladleful of plain or nut ice cream is very delicious. A few chopped nuts may be sprinkled over the top.

Chocolate Sauce.—Chocolate or cocoa, 1½ lb.; granulated sugar, 6 lb.; water (distilled or pure), 3 pt.; extract vanilla, 1½ oz.; brandy, 2 oz.; extract almond, ½ oz. Dissolve cocoa and sugar in water, strain while hot through cheese cloth; add vanilla and brandy. Keep in a chafing dish or water bath, not too hot a fire, as it solidifies or gets too thick; add a little water. Serve hot over ice cream in sundae cup.

Maple.—Pour a ladleful of hot maple syrup over vanilla ice cream, sprinkle ground hickory nuts over top. Serve with nabisco wafers.

Mint.—Over a ladleful of vanilla ice cream pour a heavy hot menthe syrup and place 3 creme de menthe cherries on top.

Strawberry.—Over a service of vanilla ice cream a ladleful of hot crushed strawberry. Do not let the strawberry reach a boiling degree, as it destroys the flavor.

Tea.

1.—*How to Prepare Tea.*—a.—In the best restaurants of the Chinese quarter in San Francisco tea is never made in a teapot, but each cup is brewed separately. The cup itself is different; it is a small bowl covered with a strainer and a lid. A tiny bundle of long tea leaves is placed in the strainer and the boiling water is poured over it. This first infusion is invariably thrown away as being unfit to drink. This procedure has caused the leaves to swell, and when next the boiling water is poured on it filters through slowly and is allowed to steep for a few moments. When the strainer is removed the golden liquid that remains in the bowl ready for drinking, without milk or sugar, is as different from the tea ordinarily served as champagne is from ginger pop.

b.—In order to make good tea it is necessary that the water should be quite boiling, but it must on no account be water that has boiled for some time or been previously boiled, cooled and then reboiled. It is a good plan to empty the kettle and refill it with fresh cold water, and make the tea the moment it reaches boiling point. Soft water makes the best tea, and boiling softens the water, but after it has boiled for some time it again becomes hard. When water is very hard a tiny pinch of carbonate of soda may be put into the teapot with the tea, but it must be used very sparingly, otherwise it may impart a very unpleasant taste to the beverage. Tea is beter made in an earthen than a metal pot. One good teaspoonful of tea will be found sufficient for two small cups, if made with boiling water and allowed to stand 3 or 4 minutes; longer than this it should never be allowed to stand. The delicate flavor of the tea may be preserved and injurious effects avoided by pouring the tea, after it has stood 3 or 4 minutes, into a clean teapot which has been previously heated.

2.—By a new process the delicate aroma and flavor of the bloom tip orange Pekoe blend has been retained. To serve —Add a dessertspoonful and fill with boiling water, add lump of sugar and whipped cream.

3.—Tea extract, 2 dr.; sugar, 2 teaspoonfuls, or rock candy syrup, 1 oz.; add cream if desired. Fill mug with hot soda and syrup.

4.—Loaf sugar, 4 cubes; extract Oolong tea, 1 dessertspoonful; prepared milk, 1 dessertspoonful; hot soda, 1 cupful; whipped cream, 1 tablespoonful. Hot water may be used instead of the hot soda.

Tomato.

1.—Usual amount of tomato extract, spoonful malted milk, little cream, hot water.

2.—Take ½ to 1 teaspoonful of beef extract, or about 1 oz. of good liquid beef extract and ½ oz. of tomato catsup, with enough hot water to fill an 8-oz. mug. Season to taste. Another tomato beef bouillon is made by taking ½ oz. of beef extract, ¼ oz. of tomato catsup and ½ oz. of cream. Stir while filling with hot water and serve with spices.

3.—Pour 2 oz. of tomato soup into a cup, add ½ oz. of sweet cream, fill with boiling water and season with salt, pepper and celery salt.

4.—Beef extract, ½ oz.; tomato bouillon extract, 1 oz. Fill cup with hot milk and serve with Graham wafers, salt and pepper.

BEVERAGES FOR THE SICK

Arrowroot.—Arrowroot, 1 dessertspoonful; castor sugar, 1 teaspoonful; milk or water, ½ pt. Mix the arrowroot smoothly with a little cold milk, boil the remainder and pour it on, stirring briskly meanwhile. Return to the stewpan and boil for 5 minutes, stirring all the time. Add the sugar and serve. If preferred. an equal quantity of water may be substituted for the milk.

Barley Water.—1.—Barley, 2 tablespoonfuls; water, 2 qt.; sugar, 1 tablespoonful. Wash the barley well; put the barley and water into a saucepan and bring it to a boil; then boil very slowly for 2 hours, strain it, add sugar and let it cool. Barley water is very cooling and nourishing. The barley may afterward be used for a pudding or put into soup.

2.—One tablespoonful of patent barley (flour), a pinch of salt, a little cold water, ½ pt. of boiling water (or milk), sugar or port to taste. Mix the barley well with cold water until a smooth paste, about the thickness of cream, is formed; then add ½ pt. of boiling water (or milk, which is preferable); put into an enameled saucepan, add sugar or wine to taste, simmer for 10 minutes, stirring all the time with a silver or wooden spoon.

Bran Tea.—Bran, 2 tablespoonfuls; honey, 1 tablespoonful; gum arabic, ¼ oz.; water, 1 pt. Boil the bran in the water for 20 minutes. Add the gum arabic and honey, stir from time to time until dissolved and strain through muslin. A useful remedy for hoarseness and sore throat.

Lemonade Preparation.—For the production of lemonade preparations for the sick the *Pharmaceutische Rundschau* gives the following recipes:

1.—Strawberry Lemonade; Citric acid, 6; water, 100; sugar, 450; strawberry syrup, 600; cherry syrup, 300; claret, 450; aromatic tincture, 15 drops.

2.—Lemonade Powder: Sodium bicarbonate, 65; tartaric acid, 60; sugar, 125; lemon oil, 12 drops.

3.—Lemonade Juice; Sugar syrup, 200; tartaric acid, 15; distilled water, 100; lemon oil, 3; tincture of vanilla, 6 drops.

4.—Lemonade Lozenges: Tartaric acid, 10; sugar, 30; gum arabic, 2; powdered starch, 0.5; lemon oil, 6 drops; tincture of vanilla, 25 drops, and sufficient diluted spirit of wine so that 30 lozenges can be made with it.

Linseed Tea.—Whole linseed, 1 oz.; licorice, ½ oz.; sugar candy, ½ oz.; the juice of ½ lemon; the finely cut rind of ¼ lemon; 1 pt. cold water. Wash and drain the linseed and simmer it with the water, licorice and lemon rind for about half an hour. Add the sugar candy, and when dissolved strain and stir in the lemon juice.

Oatmeal.—Fine oatmeal, 1 tablespoonful; water, 1 pt., or milk and water mixed; sugar to taste; a pinch of salt. Mix the oatmeal with a little cold water, boil the remainder, pour in the blended oatmeal and stir until boiling. Simmer gently for half an hour, stirring frequently. Strain, add a pinch of salt and sweeten to taste. Nutmeg, ginger, butter or cream are frequently added when the gruel is intended as a remedy for a cold.

Rice Water.—1. (Dr. Pavy).—Wash well 1 oz. of Carolina rice with cold water. Then macerate for 3 hours in 1 qt. of water kept at tepid heat, and afterward boil slowly for 1 hour and strain. May be flavored with lemon peel, cloves or other spice. This preparation is useful in dysentery, diarrhea, etc.

2.—Take of rice 2 oz., let it be well washed and add to it 2 qt. water. Boil it for 1½ hours and then add sugar and nutmeg as much as may be required. To be taken *ad libitum*. Rice, when boiled for a considerable time, assumes a gelatinous form, and, mixed with milk, is a very excellent diet for children. It possesses, in some measure, a constipating property which may by increased by boiling the milk.

Sago.—Fine sago, 1 dessertspoonful; castor sugar, 1 dessertspoonful; boiling water, ½ pt.; port wine, 1 glass. Let the water be quite boiling in a stewpan, then sprinkle in the sago and boil gently until it is quite clear, stirring from time to time. Add the sugar and wine and serve.

Toast Water.—Toast 1 crust of bread very brown and hard, but do not burn it, or it will impart a disagreeable flavor to the water. Put it into a jug, pour over it 1 pt. of cold water; let it soak for 1 hour, then strain and use.

CIDERS

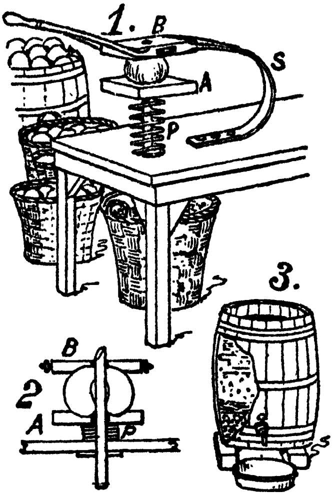
How to Make good Cider and to Keep It.—In localities where the apple crop is abundant the preparation of cider for market is a profitable industry when intelligently undertaken, and there are few beverages more palatable and less harmful than cider when properly prepared. Unfortunately there are few farmers who really know how to make good cider or how to care for and keep it when made.

In the first place, apples not perfectly sound and well ripened are not fit for making cider. The russet is one of the best of apples for this purpose, but other and more commonly available varieties need not be slighted.

To prevent bruising the fruit intended for the cider press should always be hand-picked. After sweating each apple should be wiped dry, examined, and any damaged or decayed fruit thrown out and used for making vinegar cider.

In the grinding or pulping operation the seed is often crushed and is apt to taint the juice, so that despite the loss and extra time required it is always better to core the apples before grinding them, as the cider will not only taste and look better, but keep better. A cheap and handy coring machine is shown in Fig. 1. In this the coring tube, which may be of tin, free from iron rust, projects through a common bench or table, and is surrounded by an ordinary furniture spring, P. which supports a piece of wood, A. This has a hole in the center of it, over and partly into which the apple is placed. The lever, D, on which the piece of wood, B, similar to A, but having an aperture only large enough to admit the coring tube is loosely hung by side pins, is held in position by the spring, S. The operation of the machine will be readily understood by referring to Fig. 2, in which it is shown in section.

All ironwork about the mill or press (rings, rivets, etc.) should be tinned or coated with good asphaltum varnish, as the color and sometimes taste of the cider are apt to be affected by contact with the rusty metal.



Coring Machine and Filter
CIDER MAKING

In pressing the pomace many of the best cider makers prefer to use hair cloth in place of straw between the layers, as it is more cleanly and does not affect the taste of or add anything to the expressed juice.

As the cider runs from the press it should be filtered through a hair sieve into a clean wooden vessel capable of holding as much juice as can be extracted in one day.

Under favorable conditions the fine pomace will rise to the surface in about 24 hours—sometimes less—and in a short time grow very thick. Then it should be watched, and, when white bubbles begin to appear at the surface, the liquid should be drawn off slowly from a faucet placed about 3 inches from the bottom of the tank, so as not to disturb the lees. The liquid drawn off should be received in clean, sweet casks and must be watched. As soon as white bubbles of gas appear at the bunghole, it must be drawn off (racked) into clean casks as before, and this racking repeated as often as necessary until the first fermentation is completely at an end. Then the casks should be filled up with cider in every respect like that already contained in it and bunged up tight. Many cider makers add a gobletful of pure olive oil to the cider before finally putting in the bung and storing.

If it is desired to keep cider perfectly sweet—and this is rarely the case—it should be filtered on coming from the press and then sulphured by the addition of about ¼ oz. of calcium sulphite (sulphite of lime) per gallon of cider and should be kept in small, tight, full barrels. The addition of a little sugar—say, ¼ lb. per gal.—improves the keeping qualities of tart cider.

An easily constructed cider filter is shown in Fig. 3 and consists in a barrel provided with a tap near the bottom. The lower part is filled with dry wood chips covered with a piece of flannel. Over this a layer of clean rye straw is packed down, and then the barrel is filled with clean quartz sand, not too fine.

When the first fermentation of cider has been checked and the liquid barreled it should be allowed to stand until it acquires the proper flavor.

Much of the excellency of cider depends upon the temperature at which the fermentation is conducted. The casks containing the juice should be kept in a cellar, if possible, where the temperature does not exceed 50° F. When left exposed to the air, or kept in a warm place, much of the sugar is converted into vinegar and the liquor becomes hard and rough. On the contrary, when the fermentation is conducted at a low temperature, nearly the whole of the sugar is converted into alcohol and remains in the liquid instead of undergoing acetification. The change from alcohol to vinegar (acetous fermentation) goes on most rapidly at a temperature of about 95° F., and at a lower temperature the action becomes slower, until at 46° F. no such change takes place. Independently of the difference in quality of fruit used, the respect of temperature is one of the chief causes of the superiority of the cider made by one person over that made by another in the same neighborhood.

The more malic acid and less sugar present, the less the tendency to acetous fermentation; hence it often happens that tart appels produce the best cider. But cider made from such appels can never equal in quality that prepared at a low temperature from fruit rich in sugar, which, if properly cared for, will keep good 20 years.

Whn the first fermentation has subsided, and the liquor has developed the desired flavor in storage, it is drawn off into other barrels which have been thoroughly cleansed and sulphured, either by burning in the bunghole a clean rag dipped in sulphur or, what is better, by thoroughly rinsing the inside with a solution of bisulphite of calcium prepared by dissolving about ¼ lb. of the sulphite in 1 gal. of water.

The isinglass—6 oz. or more (in solution) to the barrel—should be stirred in as soon as transferred, and then a sufficient quantity of preserving powder of bisulphite of lime (not sulphate or sulphide), previously dissolved in a little of the cider, to entirely check fermentation. The quantity of this substance required rarely exceeds ¼ oz. to the gallon of cider. A large excess must be avoided, as it is apt to injuriously affect the taste.

Some makers sweeten their cider by additions, before fining, of sugar or glucose, the quantity of the former varying from ¾ lb. to 1½ lb., while as a substitute about 3 times this quantity of glucose is required. Sweetened cider, when properly cared for, develops by aging a flavor and sparkle resembling some champagnes. Such ciders are best bottled when fined.

Artificial.—The following, when properly prepared, makes a passable substitute for cider and a very pleasant drink:

Catechu, powdered, 3 parts; alum, powdered, 5 parts; honey, 640 parts; water, 12,800 parts; yeast, 32 parts.

Dissolve the catechu, alum and honey in the water, add the yeast and put in some warm place to ferment. Fermentation should be carried on in the manner and under the precautions so frequently described in a drug paper (*i.e.*, the container should be filled to the square opening, made by sawing out 5 or 6 inches of the center of a stave, and the spume skimmed off daily as it arises). In cooler weather from 2 weeks to 18 days will be required for thorough fermentation. In warmer weather from 12 to 13 days will be sufficient. When fermentation is complete add the following solution:

Oil of bitter almond, 1 part; oil of clover, 1 part; caramel, 32 parts; alcohol, 192 parts.

The alcohol may be replaced by twice its volume of Club House of other good Bourbon whisky. A much cheaper but correspondingly poor substitute for the above may be made as follows:

1.—Twenty-five gal. of soft water, 2 lb. tartaric acid, 25 lb. brown sugar and 1 pt. of yeast are allowed to stand in a warm place, in a clean cask with the bung out, for 24 hours. Then bung up the cask, after adding 3 gal. of whisky, and let stand for 48 hours, after which the liquor is ready for use.

2.—Tartaric acid, 2 parts; common brown sugar ("New Orleans"), 25 parts; rain water, 200 parts; yeast, 1 part. Put into a clean keg or cask, with the bung out, and let stand in a warm place 24 hours. Add 25 parts of rectified spirit of wine, bung tightly and let stand 48 hours, when it will be ready for use. The above is improved by adding to each gallon of spirit from 1 to 2 fl.dr. of apple essence (obtainable from dealers in bar supplies, or probably from any wholesaler). This gives it the apple aroma and flavor.

3.—Artificial Cider.—Filtered water, 20 gal.; moist sugar, 12 lb.; tartaric acid, ½ lb.; rectified alcohol, 3 pt.; elder and melilot flowers, of each 4 oz.

When the fermentation is finished, it should be placed in a cool cellar and left to repose for 10 days, then fined with isinglass and bottle; the bottles should be kept lying down.

Bottling Cider.—To have good bottled cider, it is necessary first that care should be taken in its manufacture. Apples picked by hand and perfectly ripe and sound are essential to the best quality. They should lie some time after picking. They should then be sorted, their surface wiped dry, and all the rotten fruit rejected. The cider may then be made in the usual manner by grinding and pressing. The cider should then be stored in a cool place to mature. After 3 or 4 months it should be racked off carefully, and then fined by adding to each hogshead 1 lb. of isinglass finings. In 2 weeks from the time that the finings are added it should be again racked off, and if found sufficiently clear and sparking it is ready for bottling; if not, it should be again fined and allowed to stand 2 weeks. Before bottling, the bung should be left out of the casks for 10 or 12 hours to permit the escape of carbonic-acid gas. The cider may then be placed in bottles and the corks loosely placed in. The bottles should then be allowed to stand 24 hours. The corks may then be driven in and wired down. If the corks are driven in and wired when the cider is first put into the bottles there will be great danger of breaking the bottles by the accumulating pressure of the gas. All additions of flavoring materials are a decided damage to cider made from a fine quality of fruit, though they may improve juice of a poor quality. If the directions here given be strictly followed, a delicious cider will be produced.

Canning Cider.—Cider may be preserved sweet for years by putting it up in air-tight cans, after the manner of preserving fruit. The liquor should be first settled and racked off from the dregs, but fermentation should not be allowed to commence before canning.

Champagne Cider.—The following are some of the beverages found in the market under the name of "champagne cider" are made:

1.—Cider (pure apple), 3 bbl.; glucose syrup (A), 4 gal.; wine spirit, 4 gal.

The glucose is added to the cider, and after 12 days' storage in a cool place the liquid is clarified with ½ gal. of fresh skimmed milk and 8 oz. of dissolved isinglass. The spirit is then added and the liquor bottled on the fourth day afterward.

2.—Pale vinous cider, 1 hhd.; wine spirit, 3 gal.; glucose, about 30 lb.

The liquid is stored in casks in a cool place for about 1 month, when it is fined down with 2 qt. of skimmed milk and bottled. Much of this and similar preparations are doubtless sold for genuine champagne.

3.—Pineapple cider, 20 gal.; wine spirit, 1 gal.; sugar 6 lb.

Fine with 1 gal. of skimmed milk after 2 weeks' storage in wood and bottle.

4.—Another Formula.—Good pale vinous cider, 1 hhd.; proof spirit, 3 gal.; honey or sugar, 14 lb. Mix well, and let them remain together in a moderately cool place for 1 month, then add orange flower water, 3 pt., and in a few days fine it down with skimmed milk, ½ gal. A similar article, bottled in champagne bottles, silvered and labeled, is said to be sometimes sold for champagne.

5.—Another Formula.—To every 8 gal. of sweet, still cider add 2 pt. of strained honey, or, in its absence, 2 lb. of sugar. Stir well, bung the cask and let stand for 8 days. Add 5 fl.oz. of skimmed milk or 1-3 oz. of dissolved isinglass and immediately thereafter 2¾ pt. of diluted alcohol. Let stand for 4 days, bunging up the cask tightly.

6.—Good pale cider, 100 gal.; alcohol, 3 gal.; sugar or honey, 24 lb. Mix them. If sugar be employed, dissolve it in a part of the cider and add the solution to the remainder. Let the mixture stand during

2 weeks in a moderately cool place, taking care that fermentation does not begin. Finally take out a few gallons, mix them intimately with a few gallons of skimmed milk and incorporate the mixture thoroughly with the contents of the cask. After clarification bottle the clear liquid and secure the corks. Keep the bottles on their sides or standing top down in a moderately cool place.

Cheap Cider.—Mix well together 10 gal. cold water, 7½ lb. brown sugar, ¼ lb. tartaric acid, add the juice expressed from 2 or 3 lb. dried sour apples, boiled.

Working Formula for Cherry and Pineapple Cider or Wine.—A general working formula for making fruit wines is about as follows: Ripe selected fruit, 2 parts; granulated sugar, 1 part; water, 1½ parts; alcohol, pure (cologne spirit), sufficient.

The fruit, perfectly ripe and sound, free from decayed parts and extraneous matter, is crushed and placed in an earthen or wooden open vessel or tub, the water added and well beaten together, then allowed to stand for 48 hours, with occasional stirring, after which, by means of a press or a coarsely meshed cloth strainer, the liquid portion is separated from the mass or pulp. To the expressed liquid is added the sugar, and, when dissolved, place in a container of such capacity as nearly to fill the same. An old wine, brandy or whisky package, when free from mustiness, is preferable to a new one or one that has never been used, as these frequently impart an objectionable woody taste to the finished product. However, when such wine or liquor packages are not obtainable, the new containers should be first filled with water, allowed to soak for a day or two, then emptied and well sulphured by burning sulphur in the same. The expressed juice is then placed in the barrel and allowed to ferment, the rapidity of the fermentation depending largely upon the maintenance of the proper temperature (which is from 78 to 80° F.) and, if favorable, 4 or 5 days will suffice. It is then racked off into a clean barrel, filling nearly up to the bung-hole, leaving the same open and from day to day adding small portions of the alcohol, so that 1 gal. of the spirit is used to 50 gal of finished product. When the last of the spirit has been added, drive in the bung and allow to mature, and when it has become clear and bright it may be drawn off in bottles.

In making cherry wine some of the seeds should be crushed, as they aid in imparting the delicacy of taste and flavor of the fruit.

To Clear Cider.—Ground horseradish, 4 pts.; nearly 1 lb. of thick gray filtering paper to the barrel; shake or stir until the paper has separated into small shreds. Let it stand 24 hours, then draw off the cider by means of a siphon or stopcock.

To Improve Cider.—Cider, 1 hhd.; rum, weak flavored, 2 gal.; alum, dissolved, 1 lb.; honey or coarse sugar, 15 lb.; sugar coloring, q. s.; bitter almonds, ½ lb.; cloves, ½ lb.; mix, and after 3 or 4 days fine down with isinglass. For champagne cider omit the coloring and fine with 2 qt. milk; this will render it very pale.

Orange Cider (Orange Wine).—Many of the preparations sold under this name are not really orange ciders, but are varying mixtures of uncertain composition, possibly flavored with orange. The following are made by the use of oranges:

1.—Sugar, 8 av.lb.; water, 2¾, gal.; oranges, 15. Dissolve the sugar in the water by the aid of a gentle heat, express the oranges, add the juice and rinds to the syrup, put the mixture into a cask, keep the whole in a warm place for 3 or 4 days, stirring frequently, then close the cask, set aside in a cool cellar and draw off the clear liquid.

2.—Express the juice from sweet oranges, add water equal to hte volume of juice obtained and macerate the expressed oranges with the juice and water for about 12 hours. For each gal. of juice add 1 lb. of granulated sugar, grape sugar or glucose; put the whole into a suitable vessel, covering to exclude the dust, place in a warm location until fermentation is completed, draw off the clear liquid and preserve in well-stoppered stout bottles in a cool place.

3.—Orange wine suitable for "soda" purposes may be prepared by mixing 3 fl.oz. of orange essence with 13 fl.oz. of sweet catawba or other mild wine. Some syrup may be added to this if desired.

How to Preserve Cider.—A pure, sweet cider is only obtainable from clean, sound fruit, and the fruit should therefore be carefully examined and wiped before grinding.

In the press, use hair cloth or gunny in place of straw. As the cider runs from the press, let it pass through a hair sieve into a large open vessel that will hold as much juice as can be expressed in one day. In one day, or sometimes less, the pomace will rise to the top and in a short time grow very thick. When little white bubbles break through it, draw off the liquid through a very small spigot placed about 3 in. from the bottom, so that the less may be left behind. The cider must be drawn off into very clean, sweet casks, preferably fresh liquor casks, and closely watched. The moment the white bubbles, before mentioned, are perceived rising at the bunghole, rack it again. It is usually necessary to repeat this three times. Then fill up the cask with cider in every respect like that originally contained in it, add a tumbler of warm, sweet oil, and bung up tight. For very fine cider it is customary to add at this stage of the process about ½ lb. of glucose (starch sugar) or a smaller portion of white sugar. The cask should then be allowed to remain in a cool place until the cider has acquired the desired flavor. In the meantime clean barrels for its reception should be prepared as follows: Some clean strips of rags are dipped in melted sulphur, lighted and burned in the bunghole and the bung laid loosely on the end of the rag so as to retain the sulphur vapor within the barrel. Then tie up ½ lb. of mustard seed in a coarse muslin bag and put it in the barrel, fill the barrel with cider, add about ¼ lb. of isinglass or fine gelatine dissolved in hot water.

This is the old-fashioned way, and will keep cider in the same condition as when it went into the barrel, if kept in a cool place, for a year.

Professional cider makers are now using calcium sulphite (sulphite of lime) instead of mustard and sulphur vapor. It is much more convenient and effectual. To use it, it is simply requisite to add ⅛ to ¼ oz. of the sulphite to each gallon of cider in the cask, first mixing the powder in about a quart of the cider, then pouring it back into the cask and giving the latter a thorough shaking or rolling. After standing bunged several days to allow the sulphite to exert its full action, it may be bottled off.

The sulphite of lime (which should not be mistaken for the sulphate of lime) is a commercial article, costing about 40 cents a lb. by the barrel. It will preserve the sweetness of the cider perfectly, but unless care is taken not to add too much of it, it will impart a slight sulphurous taste to the cider. The bottles and corks used should be perfectly clean, and the corks wired down.

A little cinnamon, wintergreen or sassafras, etc., is often added to sweet cider in the bottle, together with a dram or so of bicarbonate of soda at the moment of driving the stopper. This helps to neutralize the acids and renders the liquid effervescent when unstoppered, but if used in excess it may prejudicially affect the taste.

To Keep Cider.—1.—Place in each barrel immediately on making, mustard, 4 oz.; salt, 1 oz.; ground chalk, 1 oz. Shake well.

2.—Mustard seed, 1 oz.; allspice, 1 oz.; olive oil, ¼ pt.; alcohol, ½ pt.

Cider Preservative, Bismuth as a.—L. Defour and Daniel find that the addition of 10 grams of bismuth subnitrate to each hectoliter of cider prevents, or materially retards, the hardening of the beverage on exposure to air during use from casks; not only so, but the presence of the bismuth salt renders alcoholic fermentation more complete.

To Keep Cider Sweet.—When the cider has reached the flavor required add 1 to 2 tumblerfuls of grated horseradish to each barrel of cider.

Quince Cider.—Take a quantity of ripe quinces, cut into quarters, and with the pips, etc., removed. Boil these in a copper with double their weight of water; when boiled to perfect softness pour the must into a vat. To this add, for every 50 pt. of must, 2 lb. of sugar and ½ lb. of yeast, diluted in a sufficiency of hot water. Mix the whole well together and allow to ferment. Then strain and bottle.

Raisin Cider.—This is made in a similar way to raisin wine, but without employing sugar, and with only 2 lb. of raisins to the gallon, or even more, of water. It is usually fit for bottling in 10 days and in a week longer is ready for use.

Sparkling Cider.—Sparkling cider is a brilliant, refreshing and very agreeable beverage, which will keep for a long time, and, by some connoisseurs, is preferred to champagne. Pure ciders are very rich in sugar, and they often yield a great deal of alcohol which quickly flies to the head of the consumer, as grape champagne does. Those who require a good, healthful, refreshing drink should always use the milder ciders.

In making Normandy cider, which is the most sparkling, the cider is allowed to stand for 3, 4, 5 or 6 weeks, during which fermentation proceeds. The time varies, according to the nature of the apples and also to the temperature of the store. When it is very warm the first fermentation is usually completed in 7 days. Before bottling, the liquid must be fined, and this is best performed with catechu dissolved in cold cider; 60 grams catechu per hectoliter of cider is sufficient. This is well rummaged up in the vats with a stick and then the cider is left to settle for a few days. The cider at this stage is still sweet, and it is a point of considerable nicety not to carry the first fermentation too far. Very strong bottles should obviously be employed, such, for example, as champagne bottles, and the corks should be wired down. The bottles should not be quite filled, so as to allow more freedom for the carbonic-acid gas which forms.

When the bottles have been filled, corked and wired down, they should be placed in a good cellar, which should be dry, or else the cider will taste of the cork. The bottles should not be laid for 4 or 5 weeks, or breakage will ensue. When they are being laid they should be placed on laths of wood or on dry sand; they should never be stowed on cold or damp floors.

Some makers of Normandy "champagne" have recourse to various dodges in order to increase the "gasiness" of their wares, especially if these latter are of poor quality; but these can generally be recognized. A fine bouquet is given to the best ciders by pouring into each bottle, before filling it with cider, a small liquor glass of good cognac, but some bottlers content themselves with adding a little cider brandy to the liquor about a week before bottling off. Should the cider be relatively poor in sugar, or should it have been fermented too far, then about 10 to 12 grams of powdered loaf sugar is added to each little bottle, or else a measure of sugar candy syrup, before pouring in the cider.

ALCOHOLIC BEVERAGES

Alcohol Dilution.

To make the below mentioned strengths of alcohol, the ordinary strong alcohol should be mixed with water, as follows: 85% alcohol equals 17 vol. of alcohol plus 2 of water; 80% alcohol equals 16 vol. of alcohol plus 3 of water; 75% alcohol equals 15 vol. of alcohol plus 4 of water; 70% alcohol equals 14 vol. of alcohol plus 5 of water; 65% alcohol equals 13 vol. of alcohol plus 6 of water; 60% alcohol equals 12 vol. of alcohol plus 7 of water; 55% alcohol equals 11 vol. of alcohol plus 8 of water; 50% alcohol equals 10 vol. of alcohol plus 9 of water; 45% alcohol equals 9 vol. of alcohol plus 10 of water; 40% alcohol equals 8 vol. of alcohol plus 11 of water; 35% alcohol equals 7 vol. of alcohol plus 12 of water; 30% alcohol equals 6 vol. of alcohol plus 13 of water; 25% alcohol equals 5 vol. of alcohol plus 14 of water; 20% alcohol equals 4 vol. of alcohol plus 15 of water; 15% alcohol equals 3 vol. of alcohol plus 16 of water; 10% alcohol equals 2 vol. of alcohol plus 17 of water; 5% alcohol equals 1 vol. of alcohol plus 18 of water.

Alcoholic Percentage of Liquors.

From a contribution to "The Liquor Problem" by Dr. John S. Billings the following figures are taken:

	Per cent. Alcohol.	
	Average.	Range.
American lager beer	3.8	1-7
Vienna larger beer	4.7	3-5
Munich lager beer	4.8	3-5
English ale and porter	5.0	3-7
Hard cider	5.0	4-8
American champagne	8.0	6-10
French claret	8.0	6-12
German Rhine wines, Moselle, etc	8.7	7-12
American red wine	9.0	6-12
Champagne	10.0	8-11
French white wine	10.3	9-12
Sweet catawba	12.0	10-15
Madeira	15.4	15-16
Sherry	17.5	16-20
Gin	30.0	20-40
Chartreuse	32.0	——
Whisky, American common	35.0	25-43
Whisky, Scotch, Irish	40.0	36-43
Whisky, American best	43.0	41-48
Brandy	47.0	40-50
Absinthe	51.0	——
Rum	60.0	40-80

These percentages are by weight; by volume they would, of course, be considerably larger. For instance, a whisky whose alcoholic strength in the above table would be represented by 37 would, in a table by volume, be represented by 44.

Bead for Liquors.

1.—Oil of vitriol, 2 oz.; sweet oil, 1 oz.; mixed in a glass bottle. One drop for 1 qt. of liquor.

2.—Sweet almond oil, 1 fl.oz.; sulphuric acid, concentrated, 1 fl.oz.; lump sugar, crushed, 1 oz.; alcohol, sufficient.

Triturate the oil and acid very carefully together in a glass, Wedgwood or porcelain mortar, or other suitable vessel; add by degrees the sugar, continue trituration until the mixture becomes pasty, and then gradually add enough alcohol to render the whole perfectly fluid. Transfer to a quart bottle and wash out the mortar twice, or oftener, with strong alcohol, until about 20 fl.oz. in all of the latter have been used, the washings to be added to the mixture in the bottle.

Cautiously agitate the bottle, loosely corked, until admixture appears complete, and set aside in a cool place. This quantity of "oil" is supposed to be sufficient for 100 gal. of liquor, but is more commonly used for about 80 or 85 gal. The liquor treated with this "oil" is usually allowed to become clearer by simple repose.

3.—Soapwort, coarsely ground, 13 oz.; diluted alcohol, enough to make 1 gal.

Extract the soapwort by maceration or percolation.

This is also intended for 80 gal. of liquor, preferably adding to the latter ½ gal. of simple syrup.

The ingredients of the above formulas, according to the "Manual of Beverages," are not injurious—not, at least, in the quantities required for "beading." It is said that beyond a certain degree of dilution of the liquor with water, these preparations fail to produce the intended effect. The addition of sugar or syrup increases their efficacy.

4.—Sulphuric acid, 2 vol.; sweet oil, 1 vol. Mix carefully in a glass bottle; use 1 drop for 1 qt. of liquor.

ESSENCES FOR ALCOHOLIC BEVERAGES

Bishop.—To be prepared from: Fresh green peel of unripe oranges, 60 grams; Curacoa orange peel, 180 grams; Malaga orange peel, 90 grams; Ceylon cinnamon, 2 grams; cloves, 7.5 grams; vanilla, 11 grams; orange flowers oil, 4 drops; spirit of wine, 1,500 grams; Hungarian wine, 720 grams. A dark brown tincture of pleasant taste and smell.

Bourbon.—St. John's bread, 5 grams; bruised licorice root, 5 grams; bruised orris root, 1 gram; sodium chloride, 2 grams; spirit nitrous ether, 2 grams; spirit juniper, 10 grams; alcohol, 400 grams; hot water, 600 grams; acetic ether, 3 drops. Mix the ingredients and allow them to remain in a well covered vessel for twenty-four hours; then filter.

Brandy.—Oil of prunes, 2 oz.; butyric ether, 1 dr.; oil of cognac, 4 dr.; wine ether, 1 oz.; alcohol, 4 oz.

Cherry Wine.—Essence cherry, 8 oz.; essence almonds, 2 dr.; vanillin, 4 gr.; salicylic acid, 20 gr.; tartaric acid, 2 oz.; cochineal coloring, 1 oz.; caramel, 1 oz.; water, 1 oz.; syrup, enough to make, 16 oz. Prepare as above directed.

Claret Wine.—Enanthic ether, 4 oz.; nitrous ether, 1 oz.; acetic ether, 5 oz.; wine ether, 2 oz.; rectified spirit, 4 oz.

Cognac.—Cognac oil, 1 part; ethyl acetate, 10 parts; extract raisins, 10 parts; alcohol, 100 parts.

Currant Wine, Black.—Essence black currant, 8 oz.; vanillin, 4 gr.; gingerin 5 gr.; tartaric acid, 2½ oz.; caramel, 2 oz.; salicylic acid, 10 gr.; water, 3 oz.; syrup, enough to make, 16 oz. Triturate the salicylic acid, vanillin and gingerin with the essence gradually added. Dissolve the tartaric acid in the water, add the caramel and the essence mixture and then add the syrup.

Gin.—Oil juniper, 1 oz.; oil nutmeg, 1 dr.; oil caraway, 6 minims; fusel oil, 10 minims; rectified spirit, 16 oz.

Cabinet Punch.—1.—Arrack, 3 pt.; alcohol, 1½ pt.; peel of three apples; juice of three apples; rum, 1 pt.; simple syrup, 2 pt. Burnt sugar coloring, a sufficient quantity. Digest the apple peel in the arrack, and for three days express and filter, and to this add the remaining ingredients.

2.—Arrack, 48 fl.oz.; cologne spirit, 24 fl.oz.; rum (West India), 16 fl.oz.; syrup, 32 fl.oz.; caramel, to color; peel and juice of three apples. Digest the apple peel for three days in the arrack; express, then add the other ingredients.

Madeira Wine.—Nitrous ether, 1 oz.; enanthic ether, 4 oz.; cocinic ether, 2 oz.; wine ether, 1 oz.; tincture vanilla, 4 oz.; rectified spirit to 1 pt.

May Wine.—1.—Cumarin, 1 gram; tannic acid, 50 grams; oil bitter orange, 5 grams; oil sweet orange, 5 grams; 68% alcohol, 940 grams.

2.—Galium verun, fresh, 1,000 grams; orange peel, fresh (using the yellow part only), 15 grams; Tonka beans, 10; 90% alcohol, 1,200 grams. Macerate for 24 hours, then express and filter.

Port Wine.—1.—Acetic ether, 6 fl.dr.; grape essence, 3 fl.oz.; vanilla extract, 3 fl.oz.; raspberry essence, 6 fl.oz.; tincture kino, 3 fl.oz. The grape essence may be made as follows: Enanthic ether, 1 fl.oz.; formic ether, 1 fl.dr.; acetic aldehyde, 1 fl.dr.; grape juice, 4 fl.oz.; glycerine, 2 fl.oz.; alcohol, deodorized, to make 1 pt.

2.—Acetic ether, 1 oz.; essence of grape, 4 oz.; essence of vanilla, 4 oz.; tincture of kino, 4 oz.; essence raspberry, 8 oz.

3.—Butyric ether, 2 oz.; acetic ether, 1 oz.; amyl acetate, 1½ dr.; essence vanilla, 1½ oz.; tincture orris, 2 oz.; rectified spirit to 1 pt.

Punch Essence.—1.—Rum, 2 qt.; citric acid solution, 1 fl.oz.; essence of lemon, soluble, 1½ oz.; tincture vanilla, 1 fl.oz.; tincture cinnamon, 1½ dr.; 95° alcohol, 1 to 2 pt.; add 2 qt. syrup; the alcohol may be left out.

2.—Rum, 1 pt.; cognac, ½ pt.; citric acid solution, ½ to 1 oz.; essence of lemon, soluble, 15 gr.; syrup, 1 pt.; mix.

Royal Punch.—Arrack, 20 fl.oz.; rum (West India), 20 fl.oz.; cologne spirit, 40 fl.oz.; claret, 16 fl.oz.; black cherry juice, 16 fl.oz.; raspberry juice, 3 fl.oz.; syrup, 80 fl.oz.; citric acid, 195 gr.; tincture vanilla, 8 gtt.; oil lemon, 6 gtt.; oil rose, 1 gtt. Caramel may be added to enhance the color. Some will prefer to substitute arrack for the Jamaica rum. Grated lemon rind is preferable to the oil.

Raspberry.—Amyl butyrate, 1½ fl.dr.; amyl acetate, 12 fl.dr.; acetic ether, 1½ fl.dr.; tartaric acid, 180 gr.; glycerine, 6 fl.dr.; tincture orris, 2 fl.oz.; deodorized alcohol, to make 16 fl.oz.; solution carmine, sufficient.

Rum.—1.—Ethyl butyrate, 16 parts; ethyl acetate, 3 parts; tincture vanilla, 1 part; tincture orris, 3 parts; oil birch, sufficient; alcohol, 200 parts. Two pints or more are used to 25 gallons of diluted alcohol, together with some sugar coloring. It is said that the addition of some prune juice improves the product.

2.—Acetic ether, 220 grams; nitrous ether, 70 grams; oil birch tar, 10 grams; lampblack, 200 grams; nut galls, powdered, 1,000 grams; caramel, 1,000-1,500 grams; add to 95% alcohol, 100 qt. Allow to stand for three months, then fill clear into casks.

Sherry.—1.—Spirit nitrous ether, 15 oz.; enanthic ether, 1 oz.; tincture orange, 1 oz.

2.—Enanthic ether, 1 oz.; nitrous ether, 2 oz.; rectified spirit to 1 pt.

Whisky.—Ethyl acetate, 250 parts; ethyl nitrate, 200 parts; oil caraway, 1 part; oil anise, 1 part; oil juniper, 2 parts; alcohol, 1,000 parts; sugar coloring, sufficient.

Caution.—Liquors made artificially must not be misbranded. The Department of Agriculture should be consulted as to products made artificially. The penalties against misbranding are very severe, and are strictly enforced.

LIQUORS (LIQUEURS) AND CORDIALS

Many of the following receipts for liqueurs and cordials come from the *Brewer and Distiller*, by J. Gardner, F.C.S., but the majority of the receipts were specially translated from the French, and are copyrighted by Munn & Co.

Liquors and cordials are stimulating beverages, formed of week spirit, aromatized and sweetened. The manufacture of liqueurs constitutes the trade of the compounder, rectifier or liqueurist.

The materials employed in the preparation of liquors or cordials are rain or distilled water, white sugar, clean flavorless spirit, and flavoring ingredients. To these may be added the substances employed as finings, when artificial clarification is had recourse to.

The utensils and apparatus required in the business are those ordinarily found in the wine and spirit cellar, together with a copper still, furnished with a pewter head and a pewter worm or condenser, when the method by distillation is pursued. A barrel, hogshead, or rum puncheon, sawn in two, or simply unheaded, as the case may demand, forms an excellent vessel for the solution of the sugar; and two or three fluted funnels, with some good white flannel, will occasionally be found useful for filtering the aromatic essences used for flavoring. Great care is taken to insure the whole of the utensils, etc., being perfectly clean, sweet, and well seasoned, in order that they may neither stain nor flavor the substances placed in contact with them.

French liqueurists distinguish their liqueurs as "eaux" and "extraits," or liqueurs which, though sweetened, are entirely devoid of viscidity; and "baumes," "cremes," and "huiles," which contain sufficient sugar to impart to them a syrupy consistency; usually "cremes" contain less alcohol than "huiles."

The French names are retained in the receipts. Where it is not possible to make the liquors by distillation, the receipts which say by essences should be chosen. O.p. means over proof, u.p. means under proof. (See *Alcohol.*) The abbreviations of the metric system should not be forgotten: l. = liter, gr. = gram, k. = kilogram. It should be remembered the art of the liquorist can only be obtained by long practice; still, with ordinary care, very good results can be obtained. Do not get the liquors too aromatic. This is the fault of most amateurs. All liquors should be bottled, and labeled with neat labels, and the top sealed with wax or tinfoil.

Absinthe.

1.—From the tops of *Absinthium majus*, 4 lb.; tops of *Absinthium minus*, 2 lb.; angelica root, *Calamus aromaticus*, Chinese aniseed, and leaves of dittany of Crete, of each 15 gr.; brandy or spirit at 12 u.p., 4 gal.; macerate for ten days, then add water, 1 gal.; distil 4 gal. by a gentle heat, and dissolve in the distilled spirit crushed white sugar, 2 lb.

2.—Spirit of wormwood, 172 parts; best sugar, 125 parts; orange flower water, 13½ parts; water, 125 parts. Dissolve the sugar in the water, and then add the orange flower water; thoroughly mix in the syrup the white of one egg. Next add the wormwood spirit, and heat the mixture very gently over a water bath, so as just to coagulate the albumen; immediately remove the liquid from the fire and filter.

Absinthe, Creme de (by Essences).

Essence absinthe, 0.60 gram; essence of English mint, 0.60 gram; essence of anise, 3 grams; essence of fennel, 0.80 gram; alcohol, etc., same as Chartreuse.

Ananas, Creme de.

Bananas, 800 grams; alcohol, 4 l. Crust and infuse the bananas for a week in alcohol, then pass the liqueur through a silk strainer, pour melted sugar into 2.20 l. of water, add 0.050 l. of an infusion of vanilla. Color yellow with caramel.

Aniseed Cordial.

1.—From aniseed, 2 oz., or essential oil, 1½ dr., and sugar 3 lb. per gal. It should not be weaker than about 45 u.p., as at lower strengths it is impossible to produce a full-flavored article without its being milky, or liable to become so.

Anisette (by Essences).

1.—Ess. Chinese (star) anise, 7 grams; ess. anise, 2 grams; ess. of fennel, 0.80 gram; ess. of coriander, 0.10 gram; ess. of sassafras, 0.60 gram; extract of orris, 6 grams; extract of ambergris, 0.80 gram; alcohol, etc., same as Chartreuse.

2.—Chinese anise, 5 grams; essence anise, 2 grams; essence of fennel, 0.60 gram; essence of coriander, 0.10 gram; essence of sassafras, 0.40 gram; extract of orris, 4 grams; extract of ambergris, 0.60 gram; alcohol, 85°, 3.20 l.; water, 3.90 l.; sugar, 4.375 k.

3.—*Anisette de Bordeaux.*—a.—Foreign.—Aniseed, 4 oz.; coriander and sweet fennel seeds, bruised, of each 1 oz.; rectified spirit, ½ gal.; water, 3 qt.; macerate for five or six days, then draw over 7 pt., and add of lump sugar 2½ lb.

b.—English.—Oil of aniseed, 15 drops; oil of cassia and caraway, of each 6 drops; rub them with a little sugar, and then dissolve in spirit 45 u.p., 3 qt., by well shaking them together; filter, if necessary, and dissolve in the clear liquid 1½ lb. of sugar.

Arrack.

A spirituous liquor procured by distillation from plam wine, or a fermented infusion of rice. It is imported from the East Indies, and much used to make punch. When sliced pineapples are placed in arrack, and the spirit kept for some time, it acquires a most delicious flavor, and is though to be unrivaled for making nectarial punch.

Benedictine.

Cloves, 2 grams; nutmegs, 2 grams; cinnamon, 3 grams; balm, peppermint, freshly gathered angelica and genepi of the Alps, 25 grams; calamus, 15 grams; cardamom (small), 50 grams; arnica flowers, 8 grams. Break and crush the materials, and macerate for 2 days in 4 l. of alcohol at 85°. Distil after having added 3 l. of water and draw out 4 l., after which add a cold syrup made with 4 k. of sugar and 2 l. of water. Bring up to 10 l., color, and filter.

Bitters.

Bitters are considered as tonic and stomachic, and to improve the appetite when taken in moderation. The best time is early in the morning, or an hour before meals. An excessive use of bitters tends to weaken the stomach. They should not be taken for a longer period than a fortnight at one time, allowing a similar period to elapse before again having recourse to them.

Angostura.—1.— Gentian root, 4 oz.; calisaya bark, Canada snake root, Virginia snake root, licorice root, yellow bark, allspice, dandelion root and Angostura bark, of each 10 oz.; cardamom seeds, 6 oz.; balsam of tolu, orngetis, Turkey rhubarb and galangal, of each, 4 oz.; orange peel, 1 lb.; alkanet root, 1 lb.; caraway seed, 1½ oz.; cinnamon, 1½ oz.; cloves, ½ oz.; nutmegs, coriander seed, catechu and wormwood, of each, 2 oz.; mace, 1 oz.; sanders wood, 1¼ lb.; turmeric, 8 oz. Pound these ingredients and steep them for fifteen days in 50 gal. proof spirit; before filtering add 30 lb. honey.

2.—Angostura bark, 16 parts; bitter orange peel, 8 parts; Canada snake root, 8 parts; cinchona, 8 parts; serpentaria, 8 parts; galangal, 4 parts; gentian, 4 parts; calamus, 4 parts; cardamom, 2 parts; cinnamon, 1 part; cloves, 1 part;

coriander, 1 part; mace, 1 part; alkanet root 2 parts; alcohol, 100 parts; water, 60 parts.

Phosphate.—Acid phosphate, ½ teaspoonful; Angostura bitters, 1 teaspoonful, lemon syrup, 2 tablespoonfuls, or juice of half a lemon, well sweetened. Fill glass with carbonic water.

Aromatic.—Macerate 2¾ lb. ground dried small orange apples; ¼ lb. ground dried orange peel; 2 oz. ground dried calamus root; 2 oz. ground dried pimpinella root; 1 oz. ground dried cut hops, for fourteen days, with 10 gal. of spirit at 45%; press, and add 2½ pt. brown sugar syrup. Filter. Color dark brown.

Berlin Bitters.—Dissolve in 3 qt. 80% alcohol Tr., 40 drops oil of juniper, 40 drops oil of coriander, 20 drops oil of angelica, 20 drops badian seed oil, 22 drops oil of ginger; add 3 qt. of water and ½ lb. of sugar to this solution. Filter, and color brown.

Boker's.—Quassia, 1½ oz.; calamus, 1½ oz.; powdered catechu, 1½ oz.; cardamom, 1 oz.; dried orange peel, 2 oz. Macerate for 10 days in ½ gal. strong whisky, and then filter and add 2 gal. water. Color with mallow or malva flowers.

Brandy.—Grind to coarse powder 3 lb. gentian root, 2 lb. dry orange peel, 1 lb. cardamom seeds, 2 oz. cinnamon, 2 oz. cochineal. Infuse 10 days in 1 gal. brandy, 8 gal. water, and filter.

Hamburg.—Grind to a coarse powder 2 oz. agaric, 5 oz. cinnamon, 4 oz. cassia buds, ½ oz. grains of paradise, 3 oz. quassia wood, ¾ oz. cardamom seeds, 3 oz. gentian root, 3 oz. dried orange apples, 1½ oz. orange peel. Macerate with 4¼ gal. 95% alcohol, mixed with 5¾ gal. water; add 2¾ oz. acetic ether. Color brown.

Orange.—Macerate 6 lb. orange peel for twenty-four hours with 1 gal. water, cut the yellow part of the peel from off the white, and chop it fine; macerate with 4¾ gal. 95% alcohol for two weeks, or displace; then add a syrup made of 4¼ gal. water and 16 lb. sugar. Filter through Canton flannel.

Peruvian.—Red Peruvian bark, 8 oz.; orange peel, 8 oz; cinnamon, cloves and nutmeg, 1½ dr. each; Cayenne pepper seeds, 75. Infuse them, well bruised, in 8 gal. proof spirit for 15 to 20 days, stirring every day. Draw off and filter.

Spanish.—Grind to coarse powder 5 oz. polypody, 6 oz. calamus root, 8 oz. orris root, 2½ oz. coriander seed, 1 oz. centaurium, 3 oz. orange peel, 2 oz. German chamomile flowers; then macerate with 4¾ gal. 95% alcohol, and add 5¼ gal. water and 1½ oz. sugar. Filter, and color brown.

Stomach.—Grind to a coarse powder ½ lb. cardamom seeds, ⅛ lb. nutmegs, ¼ lb. grains of paradise, ½ lb. cinnamon, ¼ lb. cloves, ¼ lb. ginger, ¼ lb. galangal, ¼ lb. orange peel, ⅛ lb. lemon peel; then macerate with 4¾ gal. 95% alcohol, and add a syrup made of 4½ gal. water and 12 lb. sugar filter.

Wild Cherry.—Wild cherry bark, 4 lb.; squaw vine (partridge berry), 1 lb.; juniper berries, 8 oz. Pour boiling water over, and let stand for 24 hours; strain, and again pour boiling water on the ingredients; let macerate for 12 hours, then express and filter through paper, so that the whole will make 5 gal., to which add 3½ lb. of sugar, 1½ gal. molasses, 6 oz. tincture of peach kernels, 3 oz. tincture of prickly ash berries, 2 qt. alcohol.

Wine.—Bruised gentian root, fresh orange and lemon peel, of each 1¼ oz.; white wine, 1 qt.; digest for a week, and strain.

Brandy.

Barrels, To Give the Appearance of Age to.—Dissolve in 3 gal. water 3 lb. sulphuric acid and 1 lb. sulphate of iron. Wash the barrels with it on the outside.

Apple, Imitation.—Cologne spirit, 40 gal.; apple brandy oil, 4 oz., cut in 1 pt. 88% alcohol; D. R. glycerine, 6 oz.; sugar syrup, ½ gal. No coloring.

Blackberry.—1.—Cologne spirit, 40 gal.; blackberry oil, 6 oz.; blackberry or cherry juice, 2 gal.; ext. blackberry, ½ pt.; sugar coloring, 4 oz., to color.

2.—To 10 gal. blackberry juice and 25 gal. spirit, 40 above proof, add 1 dr. each of oil of cloves and oil of cinnamon, dissolved in 95% alcohol, and 12 lb. white sugar dissolved in 6 gal. water. Dissolve the oils separately in ½ pt. 95% alcohol; mix both together, and use half the quantity.

3.—Cinnamon, cloves and mace, each, ¼ oz.; cardamom, 1 dr.; grind to a coarse powder; add to 16 lb. of blackberries, mashed, and 5 gal. of 95% alcohol. Macerate for two weeks; press; then add 10 lb. sugar, dissolved in 3⅝ gal. of water. Filter. This product is sometimes diluted with water, or a mixture of alcohol and water, to lessen the cost.

4.—Crushed blackberries, 4 pt.; brandy, 4 pt.; sugar, 1 lb. Macerate the berries in the brandy for 5 or 6 days, express the liquor, add the sugar, and after a fortnight decant or filter.

5.—Blackberry root, 1 lb.; cloves, 1 oz.; cinnamon, 1 oz.; syrup, 8 fl.oz.;

brandy, to make 1 gal. Exhaust the drugs by percolation or maceration with enough brandy to make 7½ pt., and add the syrup.

6.—Blackberry ether, 1 fl.dr.; blackberry juice, 16 fl.oz.; syrup, 8 to 16 fl.oz.; deodorized alcohol, to make 1 gal.; caramel, to color.

7.—Cinnamon, 2 parts; clove, 2 parts; mace, 2 parts; nutmeg, 1 part. Mix, and powder coarsely, and add to 2,000 parts crushed blackberries, freshy picked and fully ripe. Add 5,000 parts of alcohol of 95%, and let macerate together for two weeks. At end of this period strain off through woolen, press out, and to the colate add 1,300 parts of sugar, dissolved in 4,200 parts of rain or soft water. Finally, add sufficient water to bring the whole up to 12,000 parts.

8.—Mix together equal parts of mashed blackberries, raspberries and brandy, or deodorized alcohol; cover closely, and allow to stand for 48 hours; strain and press; sweeten to taste. Flavor with stick cinnamon and whole cloves; let stand, closely covered, for another 24 hours. Filter through a flannel bag, and bottle.

9.—Blackberry juice, 4 pt.; catechu, 4 oz.; cinnamon, 1 oz.; nutmeg, 1 oz.; coriander seed, 1 oz.; powdered opium, ¼ oz.; sugar, 2 lb.; alcohol, 2½ pt.; water (q. s.), 1 gal. Grind the drugs to a coarse powder, and having mixed the blackberry juice with the alcohol, macerate them for a week or 10 days in a warm place, then filter, add the sugar, dissolve by agitation, and having passed enough water through the filter, add it to the mixture to make 1 gal. of the finished product.

10.—Blackberries, 4 gal.; pimento, bruised, 4 oz.; cinnamon, bruised, 3 oz.; cloves, bruised, 2 oz.; brandy, 64 oz.; sugar, enough. Crush the fresh, cleaned fruit, transfer the pulp to a kettle, add the spices, and gradually raise the temperature to the boiling point, allowing to ebullesce for a few minutes. Then strain through flannel, and add sugar in the proportion of 1 lb. for each pint of the juice. Dissolve the sugar by the aid of heat, and again raise to the boiling point, removing the scum with a ladle or clarify by straining. When cold add the brandy. The dose is given at from ½ to 2 fl.oz.

11.—Blackberries, ripe, 16 fl.oz.; blackberry root, 1 av.oz.; mace, 1 dr.; cloves, 1 dr.; allspice, 1 dr.; cassia, 1 dr.; ginger, 1 dr.; port wine, 4 fl.oz.; alcohol, 2 fl.oz.; water, enough. Express the juice from the berries and add sufficient water through the residue to make the expressed liquid measure 12 fl.oz.; add the alcohol and wine. Mix the drugs and reduce to medium fine powder moisten with the expressed liquid, pack lightly in a percolator, macerate for 24 hours, percolate, and if the percolate is less than 16 fl.oz., add enough menstruum, consisting of 1 part alcohol and 4 parts water, to make up the measure.

British Brandy.—Syn. Malt Brandy.—For a long time this liquor was distilled from spoiled wine and the dregs of wine, both British and foreign, mixed with beer bottoms, spoiled raisins, and similar substances. At the present day, spirit made from malt, potatoes, beet root and carrots is employed. Malt spirit is the best adapted for the manufacture of British brandy. We annex formulas:

1—To 12 gal. of malt spirit at proof add of water 5 gal.; crude red tartar or winestone previously dissolved in 1 gal. of boiling water, ¾ lb.; acetic ether, 6 fl.oz.; French wine vinegar, 2 qt.; French plums, bruised, 5 lb.; sherry bottoms, ½ gal.; mix these ingredients in a sherry or French brandy cask, and let them stand for about a month, frequently stirring the liquid with a stick; next draw over 15 gal. of the mixture from a still furnished with an agitator. Put the distilled spirit into a clean, fresh emptied cognac brandy cask, and add of tincture of catechu, 1 pt.; oak shavings, 1 lb.; spirit coloring, ½ pt.; agitate occasionally for a few days, and then let it repose for a week, when it will be fit for use. This produces 15 gal. of brandy, 17 u. p. Age greatly improves it.

2.—Malt spirit, 99 gal.; tartar, dissolved in water, 7 lb.; acetic ether, ½ gal.; wine vinegar, 5 gal.; bruised raisins or French plums, 14 lb.; bitter almond cake, bruised, and steeped for 24 hours in twice its weight of water, which must be used with it, ¼ lb.; water, q. s.; macerate as before, and draw over, with a quick fire, 120 gal. To the distilled spirit add a few pounds of oak shavings, 2 lb. of powdered catechu made into a paste with hot water, and spirit coloring, q. s., and finish as in the last. Produces 120 gal. of spirit, fully 17 u. p. Equal in quality to the last.

Caraway Brandy.—1.—A species of cordial, commonly prepared as follows: Bruised caraway seeds, 4 oz.; lump sugar, 2 lb.; British brandy, 1 gal.; macerate a fortnight, occasionally shaking the bottle.

2.—Sugar, 1 lb.; bruised caraways, 1

oz.; bitter almonds, grated, 3; spirit coloring, 1 oz.; plain spirit or gin, 22 u. p., ½ gal. Infuse, etc., as balm of Molucca. The coloring is sometimes left out.

Catawba.—Cologne spirit, 40 gal.; Catawba brandy oil, 6 oz.; wine syrup, 2 lb., cut in 1 qt. 88% alcohol Color with French brandy coloring.

Cherry.—1.—Cologne spirit, 40 gal.; cherry brandy oil, 6 oz., cut in 1 pt. 88% alcohol; cherry juice, 2 gal.; sugar syrup, 1 qt.; cherry extract, 1 pt.; sugar coloring, to color, 4 oz.

2.—Brandy and cherries, crushed, of each 1 gal.; let them lie together for 3 days, then express the liquid and add 2 lb. lump sugar; in a week or two decant the clear portion for use.

3.—To the last add 1 qt. raspberry juice and ½ pt. orange-flower water. Both the above are excellent.

4.—Molasses 1 cwt.; spirit, 45 u. p., 41 gal.; bitter almonds, bruised, 1 lb., more or less, to taste; cloves, 1 oz.; cassia, 2 oz.; macerate a month, frequently stirring. An article frequently sold as cherry brandy.

5.—German cherry juice, 15 gal.; pure rectified spirit, 20 gal.; syrup, 5 gal.; oil of bitter almonds, 1 dr.

6.—Black cherries, mashed, without being stoned, 8 lb.; 95% alcohol, 10 qt. Macerate for 2 weeks; press; add 5 lb. sugar, dissolved in 2 gal. brandy.

7.—Sound black cherries. To each lb. allow 3 oz. of brown sugar candy, 12 apricot, peach or plum kernels, ¼ oz. shredded bitter almond, ¼ inch of cinnamon, and good French brandy to cover. Cut off the stalks, leaving them about half an inch in length, wipe the cherries with a soft cloth, and prick them well with a coarse darning needle. Half fill some wide-necked bottles with the prepared fruit; to each one add sugar candy, etc., in the above stated proportions, and fill the bottles with brandy. Cork closely, cover the top with melted wax, or bladder, and keep for at least 3 months before using.

Dantzic Brandy.—From rye, ground with the root of *Calamus aromaticus*. It has a mixed flavor of orris and cinnamon.

1.—The *Munchener Apotheker Verein* has adopted the following formula for the same thing: Acetic acid, dilute, 90%, 4 parts; acetic ether, 4 parts; tincture aromatic, 40 parts; cognac essence, 40 parts; spirit of nitrous ether, 20 parts; 90% alcohol, 5,000 parts; distilled water, 2,500 parts. Add the acids, ethers, etc., to the alcohol, and finally add the water. Let stand several days, and, if necessary, filter.

2.—Berlin apothecaries have adopted the following as a magistral formula: Aromatic tincture, 4 parts; spirit of nitrous ether, 5 parts; 90% alcohol, 1,000 parts; distilled water, q. s. to make 2,000 parts. Mix the tincture and ether with the alcohol, add the water, and for every ounce add one drop of tincture of rhatany. Of these formulae, the first is to be preferred, as a close imitation of the taste of the genuine article. To imitate color use burnt sugar.

Ginger.—1.—The following is a German formula, and it makes a first-rate article: Sugar, 200 parts; tincture of orange peel, 20 parts; spirit of nitrous ether, 20 parts. Mix, and add 4,500 parts of good whisky or dilute alcohol. Stir in 5,500 parts of boiling rain or soft water, adding at the same time 200 parts of ginger, in powder, and 20 parts of galangal root, powdered. If desired, add enough burnt sugar to color. Cover the vessel, and let stand a day or two; then filter. By adding the ginger after the water we avoid dissolving the resinous parts of the former, which would otherwise make the preparation turbid. The galangal may be omitted, if desired, and about a drop of oil of bitter almond added in its place, for every 2½ gal. of liquor. It should be dissolved in the alcohol before adding.

2.—Jamaica ginger, 2 oz.; brandy, 1 qt.; water, ½ pt.; sugar, 1 lb.; juniper berries (mixed black and white), 2 oz. Crush finely the ginger and juniper berries, put them into a wide-necked bottle, and pour in the brandy. Crok securely, let the bottle stand in a warm place for 3 days, shaking it 3 or 4 times daily. On the third day boil the sugar and water to a thick syrup, and when cool add to it the brandy, which must previously be strained through fine muslin or filtering paper until quite clear. When quite cold, bottle, cork securely, and store for use.

3.—Cologne spirits, 40 gal.; ginger brandy oil, 1½ lb.; sugar syrup, ½ gal.; sugar coloring 6 oz.

Lemon.—1.—Fresh lemons, sliced, 1 doz.; brandy, 1 gal.; macerate for a week, press out the liquid, and add 1 lb. lump sugar.

2.—Proof spirit, 7 gal.; essence of lemon, 3 dr.; sugar, 5 lb.; tartaric acid, 1 oz.; dissolved in water; turmeric powder, 2 gal.; spirit coloring, 1 dessertspoonful; macerate, etc., as No. 1. Sometimes boiling milk is added to the above, in the proportion of 1 qt. to every gal.

Malt.—Malt spirit, flavored with sweet spirits of niter and terra japonica, and colored with molasses, or spirit coloring. (See *British Brandy.*)

New York Brandy.—Cologne spirit, or good rectified spirits, 40 gal.; New York brandy essence, 2 oz.; prussic ether, 1 oz., dissolved in 1 pt. 88% alcohol. To improve, add 1½ pt. sugar syrup. Color with sugar coloring.

Orange Brandy.—1.—To every ½ gal. of brandy allow ¾ pt. of Seville orange juice, 1¼ lb. loaf sugar. To bring out the full flavor of the orange peel, rub a few lumps of the sugar on 2 or 3 unpared oranges, and put these lumps to the rest. Mix the brandy with the orange juice, strained, the rinds of six of the oranges, pared very thin, and the sugar. Let all stand in a closely covered jar for about three days stirring it three or four times a day. When clear it should be bottled and closely corked for a year; it will then be ready for use, but will keep any length of time. This is a most excellent stomachic when taken pure, in small quantities; or, as the strength of the brandy is very little deteriorated by the other ingredients, it may be diluted with water. To be stirred every day for three days. Sufficient to make 2 qts.; make this in March.

2.—As lemon brandy, but substituting oranges.

Patent Brandy.—This is merely very clean malt spirit mixed with about one-seventh or less of its bulk of strongly flavored cognac and a little coloring.

Peach.—1.—Mash 18 lb. of peaches with their stones; macerate them for 24 hours, with 4¾ gal. of 95% alcohol and 4 gal. of water. Strain, press, and filter; add 5 pt. plain white syrup. Color dark yellow with burnt-sugar coloring.

2.—(Good.) Take ½ gal. of honey, dissolved in water; 3¾ gal. of 95% alcohol; ½ gal. Jamaica rum; 1 oz. catechu, bruised to a paste; 1 oz. acetic ether. Add water to make 10 gal, flavored with 4 oz. of bitter almonds. No coloring required.

3.—From peaches, by fermentation and distillation. Much used in the United States. A cordial spirit under the same name is prepared as follows:

4.—From peaches, sliced, and steeped in twice their weight of British brandy or malt spirit, as in making cherry brandy.

5.—Bitter almonds, bruised, 3 oz.; proof spirit, 10 gal.; water, 8 gal; sugar, 5 or 6 lb.; orange-flower water, ½ pt.; macerate for 14 days; add brandy coloring, if required darker.

6.—Dissolve 1 gal. of honey in water; add 7 gal. of alcohol, 1 gal. of rum, 2 oz. of catechu, bruised, 2 oz. acetic ether; add ½ lb. of bitter almonds; dissolved, 20 gal. water.

7.—Cologne spirit, 40 gal.; peach brandy oil, ¼ lb.; glycerine, 6 oz.; sugar syrup, ½ gill. No coloring.

Raspberry Brandy.—1.—Put 1 pt. of ripe raspberries into a wide-necked bottle, pour 1 qt. of French brandy over them, cork the bottle tightly, and let it stand in a moderately warm place for 14 days. Have ready a thick syrup, made by boiling together ¼ lb. of loaf sugar and 2 tablespoonfuls of cold water until the right consistency is obtained. Strain the liquor from the bottle repeatedly until quite clear, then mix it with the syrup, and pour the whole into small bottles. Cork them securely, and store for use.

2.—Pour as much brandy over raspberries as will just cover them; let it stand for 24 hours, then drain it off and replace with a like quantity of fresh spirit; after 24 hours more drain this off and replace it with water; lastly, drain well and press the raspberries quite dry. Next add sugar to the mixed liquors, in the proportion of 2 lb. to every gal., along with ¼ pt. of orange-flower water.

3.—Mix equal parts of mashed raspberries and brandy together, let them stand 24 hours, then press out the liquor. Sweeten as above, and add a little cinnamon and cloves, if agreeable; lastly, strain.

4.—From raspberries, using the proportion given under cherry brandy. Sometimes a little cinnamon and cloves are added. The only addition, however, that really improves the flavor or bouquet is a little orange-flower water, a very little essence of vanilla, or a single drop of essence of ambergris.

5.—Shrub.—Brandy, 1 gal.; orange and lemon juice, of each, 1 pt.; the peel of 2 oranges; ditto of 1 lemon; digest for 24 hours, strain, and add 4 lb. of white sugar dissolved in 5 pt. water. After a fortnight decant the clear liquid for use.

Cacao, Creme de.

Infuse 1 lb. roasted Cacao nuts cut small and ½ oz. vanilla, in 1 gal. brandy, for 8 days; strain, and add 3 qt. of thick syrup.

Caraway Cordial.

This is generally made from the essential oil of caraway, with 2½ lb. of sugar per gal.; 1 fl.dr. of the oil is commonly reckoned equal to ¼ lb. of the seed. The addition of a very little oil of cassia and about half as much of essence of lemon or of orange improves it.

Cassis, Creme de.

Infusion of currants, 4.20 l.; spirit of raspberries, 0.50 l.; 85% alcohol, 0.60 l.: white sugar, 5 k.; water, 1.60 l.

Celeri, Creme de.

Essence of celery, 2 grams; alcohol, 3.10 l.; water, 3.90 l.; sugar, 4.375 k.

Chartreuse.

Ingredients.	Green.	Yellow.	White.
China cinnamon	1.50 gr.	1.50 gr.	12.50 gr.
Mace	1.50 gr.	1.50 gr.	3 gr.
Lemon balm, dried	50 gr.	25 gr.	25 gr.
Hyssop in flow tops	25 gr.	12.50 gr.	13.50 gr.
Peppermint, dried	25 gr.	....	....
Thyme	3 gr.	....	....
Balsime (bal. maj.)	12.50 gr.	....	....
Genèpi	25 gr.	12.50 gr.	12.50 gr.
Arnica, flowers of	1 gr.	1.50 gr.	....
Balsam poplar buds	1.50 gr.	....	....
Angelica, seeds	12.50 gr.	12.50 gr.	12.50 gr.
Angelica, roots	6.25 gr.	3 gr.	3 gr.
Coriander	....	1.50 gr.	..
Cloves	....	1.50 gr.	3 gr.
Aloes, socotrine	....	3 gr.	....
Cardamom, small	....	5 gr.	3 gr.
Nutmegs	....	....	1.50 gr.
Calamus	....	....	30 gr.
Tonka beans .		....	1.50 gr.
Alcohol, at 85°	6.25 l.	4.25 l.	5.25 l.
White sugar..	2.50 k.	2.50 k.	3.75 k.

Digest in alcohol for 24 hours; distil so as to obtain nearly all the spirit; repeat the operation, if necessary, or add water to make 10 l.; color, and, after reposing, filter.

2.—Chartreuse, by Essences.—Essence of lemon balm, 0.20 gram; essence of hyssop, 0.20 gram; essence of angelica, 1 gram; essence of English mint, 2 grams; essence of Chinese cinnamon, 0.20 gram; essence of cloves, 0.20 gram; essence of nutmegs, 0.20 gram. Color yellow or green. Alcohol (85%), 3 l.; sugar, 5.6 k.; water, 2.6 l.; for 10 l.

3.—Grande Chartreuse.—This renowned liqueur, formerly made by the monks of the Grande Chartreuse, near Grenoble, is said to have the following composition: Essence of balm (flavored with lemon), 31 gr.; essence of hyssop, 31 gr.; essence of angelica, 2½ dr.; essence of English peppermint, 5 dr.; essence of nutmeg, 36 gr.; essence of cloves, 31 gr.; rectified alcohol, 3½ pt.; sugar, q. s.; the whole being colored yellow or green, according to taste.

Cherry Cordial.

Mix 2¼ lb. cherry juice with 1½ qt. 80% alcohol; add 8 drops oil of cloves, ½ lb. sugar, 1¾ qt. water; filter.

Coffee Liquer.

Ground roasted coffee, 112 parts; diluted spirit, 450 parts. Digest, express, and filter. To 300 parts of the filtered liquid add: Tincture of vanilla, 5 parts; diluted spirit, 150 parts; simple syrup, 225 parts.

Cognac.

Good spirits, distilled or rectified, 40 gal.; enanthic ether, 6 oz.; cognac brandy oil (dissolved in 1 qt. 88% alcohol), 1 oz.; wine syrup, 1½ lb.; color with sugar coloring.

Coloring of Liqueurs.

Amber, Fawn and Brandy Color.—1.—Burnt-sugar or spirit coloring.

2.—Best white crushed or lump sugar, 6 lb.; water, ¾ pt. Boil until black: remove from the fire, cool with water, stirring as the water is added. Used to color liquors from a light amber to a dark brown. For brandy, whisky, old rye, etc.

Blue.—Sulphate of indigo, nearly neutralized with chalk and the juice of blue flowers and berries.

Green.—Spinach or parsley leaves digested in spirit and mixtures of blue and yellow.

Port Wine Color.—Extract of rhatany.

Purple.—The same as violet, only deeper.

Red.—1.—Cudbear, 400 grams; 85° alcohol, 1 l. Macerate for five days, stirring residue in the same manner, unite the two liquids, and filter.

2.—Powdered cochineal or Brazil wood, either alone or mixed with a little alum.

3.—Beet root, red saunders, or cochineal.

Violet.—Blue violet petals, litmus, or extract of logwood.

Yellow.—1.—An aqueous infusion of safflower or French berries and the tinctures of saffron and turmeric.

2.—Saffron, 100 gr.; water, 1.5 l. Boil half the water and pour on the saffron. Cover tightly, and macerate until the infusion is cold. Repeat the operation on the residue, and mix the two liquids; add 750 c. c. of 85% alcohol, and filter.

Cordial.

Aromatized and sweetened spirit, employed as a beverage. Cordials are prepared by either infusing the aromatics in the spirit and drawing off the essence by distillation, which is then sweetened, or without distillation, by flavoring the spirit with essential oils, or simple digestion on the ingredients, adding sugar or syrup as before. Malt or molasses spirit is the kind usually employed, and for this purpose should be perfectly flavorless, as if this be not the case the quality of the cordial will be inferior. Rectified spirit of wine is generally the most free from flavor, and when reduced to a proper strength with water forms the best and purest spirit for cordial liquors.

Curacoa (by Essences).

Essence of curacoa, distilled, 7 grams; essence of Portugal, 2.50 grams; essence of cloves, 5 grams. Bitter infusion of curacoa, q. s.; alcohol, 3.10 l.; water, 3.90 l.; sugar, 4.375 k.

Dantzich, Eau de Vie de (by Essences).

1.—Essence Ceylon cinnamon, 40 gr.; essence China cinnamon, 1.20 gr.; essence of coriander, 0.20 gr.; essence of lemon (distilled), 0.80 gr.; alcohol, etc., the same as curacoa.

2.—Ceylon cinnamon, 25 gr.; cloves, 1.5 gr.; green anise, 12.5 gr.; celery seeds, 12.5 gr.; caraway seeds, 12.5 gr.; cumin seeds, 3 gr.; 85% alcohol, 5 l.; white sugar, 2.5 k. General method without rectification. Product, 10 l.

Dubonnet.

A very popular French preparation. Its composition has not been disclosed. Makes excellent cocktails when added to equal parts of gin or whisky. Use no bitters.

Fining for Cordials (Eggs).

Take the white of an egg with each 5 gal. of the cordial, beat up with alcohol, and add gradually to the cordial.

Fining with Potash.

For each 10 gal. of the cordial add 1 oz. of potassium carbonate dissolved in 1 pt. of water; add gradually.

Gin.

1.—Clean corn spirit, at proof, 80 gal.; newly rectified oil of turpentine, 1 pt.; mix well by violent agitation; add 7 or 8 lb. culinary salt dissolved in 30 or 40 gal. of water; again well agitate, and distil over 100 gal., or until the feints begin to rise. Product, 100 gal., 22 u. p., besides 2 gal. contained in the feints. If 100 gal., 17 u. p., be required, 85 gal. of proof spirit, or its equivalent at any other strength, should be employed.

2.—Proof spirit, as above, 8 gal.; oil of turpentine, 1 to 1½ oz.; salt (dissolved in 3 or 4 gal. of water), 1 lb.; draw 10 gal. as before, 22 u. p.

3.—Clean corn spirit, 80 gal.; oil of turpentine, ¾ to 1 pt.; pure oil of juniper, 1 to 3 oz.; salt, 7 lb.; water, 35 gal.; draw 100 gal., as above, 22 u. p.

4.—To the last add oil of caraway, ½ oz.; oil of sweet fennel, ¼ oz.; distil as before.

5.—To No. 3 add essential oil of almonds, 1 dr., or less; essence of lemon, 3 or 4 dr.; distil as before.

6.—To No. 1 add creosote, 1 to 2 dr., before distillation.

7.—To No. 3 add creosote, 1 to 2 dr., before distillation.

8.—Proof spirit, 80 gal.; oil of turpentine, ½ pt.; oil of juniper, 3 oz.; creosote, 2 dr.; oranges and lemons, sliced, of each 9 in number; macerate for a week, and distil 100 gal., 22 u. p.

The oil of turpentine for this purpose should be of the best quality, and not that usully vended for painting, which contains rosin and fixed oil. Juniper berries, bitter almonds and the aromatic seeds may be used instead of the essential oils, but the latter are most convenient. Turpentine conveys a plain gin flavor, creosote imparts a certain degree of smokiness, lemon and other aromatics a creaminess, fullness and richness. Gin may also be prepared by simple solution of the flavoring in the spirit, but is, of course, better for distillation.

Sweetened gin is made from unsweetened gin, 22 u. p., 95 gal.; lump sugar, 40 to 45 lb., dissolved in 3 gal. of clear water; mix well, and fine it down as above. Produces 100 gal., at 26 u. p. This, as well as the last, is usually permitted at 22 or 24 u. p., which is also done when the gin has been further lowered with water so to be even 30 or 35 u. p.

9.—*Raspberry.*—Break 1 lb. of sugar candy in small pieces, put it into a jar with 1 qt. of ripe raspberries and 1 qt. of good gin, cover closely, and let it remain thus for 12 months, shaking it daily for 3 or 4 weeks. At the end of the time strain or filter until clear, and bottle foruse.

Gold Cordial.

From angelica root, sliced, 1 lb.; raisins, ½ lb.; coriander seeds, 2 oz.; caraway seeds and cassia, of each 1½ oz.; cloves, ½ oz.; figs and sliced licorice root, of each 4 oz.; proof spirit, 3 gal.; water, 1 gal.; digest 2 days, and distil 3 gal. by a gentle heat; to this add, of sugar, 9 lb., dissolved in rose water and clean soft water, of each 1 qt.; lastly, color the liquid by steeping in it 1¼ oz. of hay saffron. This cordial was once held in much esteem for its supposed medicinal virtues, the formula being mentioned by Arnold de Villeneuve. It derives its name from a small quantity of gold leaf formerly being added to it, which was supposed to add greatly to its remedial value. Until comparatively recent years gold was credited with extraordinary remedial powers.

Hollands.

1.—Geneva, Dutch Gin (Dutch Method).—The materials employed in the distilleries of Schiedam, in the preparation of this excellent spirit, are 2 parts of the best unmalted rye and 1 part of malted barley, reduced to the state of coarse meal by grinding. About a barrel (36 gal.) of water, at a temperature of from 162 to 168° Fah., is put into the mash tun for every 1½ cwt. of meal, after which the malt is introduced and stirred; and lastly, the rye is added. Powerful agitation is next given to the magma till it becomes quite uniform, when the mash tun is covered over with canvas and left in this state for 2 hours. Agitation is then again had recourse to, and the transparent spent wash of a preceding mashing is added, followed by as much cold water as will reduce the temperature of the whole to about 85° Fah. The gravity of the wort at this point varies from 33 to 38 lb. A quantity of the best pressed Flanders yeast, equal to 1 lb. for every 100 gal. of the mashed materials, is next stirred in, and the whole is fermented in the mash tun for about 3 days, or until the attenuation is from 7 to 4 lb. (sp. gr., 1.007 to 1.004). During this time the yeast is occasionally skimmed off the fermenting wort. The wash, with the grains, is then transferred to the still, and converted into low wines. To every 100 gal. of this liquid 2 lb. of juniper berries (3 to 5 years old) and about 1 lb. of salt are added, and the whole is put into the low wine still, and the fine spirit drawn off by a gentle heat, one receiver only being employed. The product per quarter varies from 18 to 21 gal. of spirit, 2 to 3 o. p.

2.—**Best Hollands.**—Hollands rectified to the strength of 24° Baume (sp. gr., 0.9125, or about 6 o. p.).

3.—Dr. Thompson gives the following formula for preparing gin, Geneva or Hollands. He states it is one used by the Dutch manufacturers: 112 lb. of barley malt and 228 lb. or rye meal are mashed with 460 gal. of water at 162° Fah. After infusing a sufficient time, cold water is added until the gravity of the wort is reduced to 45 lb. per barrel. The whole is let into a fermenting bath at 80° Fah., ½ gal. yeast is added, the temperature rises to 90°, and the fermentation is over in 48 hours. Both the wash and grains are then put into the still, the low wines are distilled off, these are redistilled, and the production is rectified. A few juniper berries and some hops are used to communicate a peculiar flavor to the spirit.

4.—English-made.—From juniper berries (at least a year old, and crushed in the hands), 3 lb.; rectified spirit, 1½ gal. (or proof spirit, 2½ gal.); digest, with agitation, for a week, and then express the liquid; after 24 hours' repose decant the clear portion, add it to good corn spirit at 2 or 3 o. p., 90 or 100 gal., and mix them well together.

5.—From juniper berries, 2½ lb.; sweet fennel seed, 5 oz.; caraway seeds, 3½ oz.; proof spirit, 2 gal.; corn spirit, 90 or 100 gal.

Kirschwasser.

A spirituous liquor, distilled in Germany and Switzerland from bruised cherries. From the rude manner in which it is obtained, and from the distillation of the cherry stones (which contain prussic acid) with the liquid, it has often a nauseous taste, and is frequently poisonous. When properly made and sweetened it resembles noyeau.

Maraschino (Marasequin).

1.—A delicate liqueur spirit distilled from a peculiar cherry growing in Dalmatia, and afterward sweetened with sugar. The best is from Zara, and is obtained from the marasca cherry only. In the middle of the last century the profits arising from the sale of this compound were so considerable that the Senate of Venice, where it was principally manufactured, monopolized the trade in it. An inferior quality is distilled from a mixture of cherries and the juice of licorice root.

2.—(*ara.*)—Essence of noyeau, 3.5 grams; essence of neroli, 0.5 gram; extract of jasmine, 1 gram; extract of vanilla, 1.5 grams; alcohol, etc., same as for chartreuse.

Mint.

1.—*Cordial.*—a.—oil of peppermint, ¼ oz.; syrup, 2½ pt.; rectified spirits, 5 pt.; alcohol, ½ pt. Color light green.

b.—Best Holland gin, 26 oz.; fresh peppermint water, 26 oz.; sugar, 20 oz. Mix, and agitate until the sugar is dissolved; then filter clear.

2.—*Creme de Menthe.*—a.—Put 2 oz. of green mint into a jar, pour over 1 qt. of 90% alcohol, registering 50° by Gay Lussac's alcoholometer, and let it steep for 8 days; add 3 gills of syrup registering 30° on the saccharometer, mix it with some filtering paper, and pour the whole into a filtering bag. When the liqueur is thus strained it should be perfectly clear and limpid; bottle it, and keep the bottles in a dry place.

b.—Oil of peppermint, ¼ fl.oz.; alcohol, 5 pt.; syrup, 2½ pt.; mint leaves, 2 oz.; alcohol, 1 qt. Digest for a week, and then add 1 pt. of heavy syrup. Mix, add some filter paper, cut up in small pieces, shake well, and filter clear.

c.—Oil of peppermint, 10 parts; oil of lemon, 1 part; chloroform, 5 parts; acetic ether, 5 parts; sugar, 4,000 parts; alcohol, 10.250 parts; distilled water, 10.250 parts. Macerate, shake frequently, and filter.

Nectar.

The fabled drink of the mythological deities. The name was formerly given to wine dulcified with honey; it is now occasionally applied to other sweet and pleasant beverages of a stimulating character. The following liqueur is so called: Chopped raisins 2 lb.; loaf sugar, 4 lb.; boiling water, 2 gal.; mix, and stir frequently until cold; then add 2 lemons, sliced; proof spirit, brandy or rum, 3 pt.; macerate in a covered vessel for 6 or 7 days, occasionally shaking; next strain with pressure, and let the strained liquid stand in a cold place for a week to clear; lastly, decant the clear portion and bottle it.

Noyeau.

Creme de Noyeau.—This is a pleasant, nutty-tasted liquor, but from the large proportion of prussic acid which it contains it should be partaken of very moderately.

1.—Bitter almonds, bruised, 3 oz.; spirit, 22 u. p., 1 qt.; sugar (dissolved in ¾ pt. of water), 1 lb.; macerate for 10 days, frequently shaking the vessel, then allow it to repose for a few days, and decant the clear portion.

2.—As the last, but substituting apricot or peach kernels, with the bruised shells, for the almonds.

3.—To either of the above add coriander seed and ginger, of each, bruised, 1 dr.; mace and cinnamon, of each, ¼ dr.

4.—Creme de Noyeau de Martinique.—Loaf sugar, 24 lb.; water, 2½ gal.; dissolve; add of proof spirit, 5 gal.; orange-flower water, 3 pt.; bitter almonds, bruised, 1 lb.; essence of lemons, 2 dr.

Orange, Creme de.

From sliced oranges, 3 doz.; rectified spirit, 2 gal.; digest for 14 days; add of lump sugar, 28 lb., previously dissolved in 4½ gal. of water; tincture of saffron, 1½ fl.oz.; orange-flower water, 2 qt.

Parfait Amour.

Perfect Love.—Flavored with the yellow rind of 4 lemons and a teaspoonful of essence of vanilla to the gal., with 3 lb. sugar, a sufficient quantity of powdered cochineal to color.

Peach Cordial.

Pour 3½ gal. of 90% alcohol, Tr., over 2 lb. sliced peaches; digest from 8 to 10 days; filter, and add 3 gal. white wine, 15½ lb. of sugar dissolved in 3½ qt. of water.

Peppermint.

1.—*Peppermint Cordial, Sportsman's Cordial, Eau de Chasseurs.*—This well-known compound is perhaps in greater demand in every part of the country than all the other cordials put together. From peppermint water and gin or plain spirit, 22 u. p., of each 1 pt.; lump sugar, ¾ lb.

2.—Peppermint Water.—Peppermint flowers, 1 k.; water, 4 l.; salt, 250 grams; macerate, and draw off 2 l.

Pineapple.

1.—*Cordial.*—Pineapple extract, 3 oz.; extract of lemon, ¾ oz.; syrup, 1½ gal.; rectified spirits, 2¼ gal.

2.—*Liqueur.*—Take ½ lb. of peeled pineapple, and cut it into slices; boil 3 qt. of syrup until it registers 38° on the saccharometer; add the slices of pineapple, the juice of 4 oranges and the yellow peel of 2 oranges; let it boil up, and pour the whole into a jar. Close the jar carefully, and let the pineapple infuse thus for 2 days. Strain the syrup through a hair sieve, mix with 1 qt. of 90% alcohol registering 35° by Gay Lussac's alcoholometer, and filter the whole through a felt filtering bag. Bottle the liqueur, and keep in a dry place.

Prunelle Cordial.

Prunes, 3 oz.; milk, 3 oz.; alcohol, 24 oz.; sugar, 24 oz.; distilled water, 24 oz. Cut up the fruit fine and crush the stones so as to bruise the kernels, and macerate with the alcohol for a week or ten days, agitating frequently. Decant the liquid; to the marc add the milk (boiling hot), and macerate for one day. Then mix with the decanted liquid, strain, and add the sugar, previously dissolved in the water; then filter clear.

Quince Liqueur.

Grate a sufficient quantity of quinces over a basin to obtain 2 lb. of pulp: add 1 qt. of syrup registering 30° on the saccharometer; cover the basin, and let it remain thus for one day; pour the contents of the basin into a filtering bag, add 1 pt. of 90% alcohol registering 35° by Gay Lussac's alcoholometer, to the strained syrup; mix, and pour the whole again through a filtering bag, and bottle the liqueur.

Raspberry Cordial.

1.—From raspberry brandy, syrup and water, equal parts. A similar article is prepared by flavoring sweetened spirit with the artificial raspberry essence.

2.—Raspberry juice, 24 ounces: alcohol, 15 ounces; distilled water, 18 oz.; sugar, 14 oz. Mix the juice and the alcohol (and if desired, add 3 drops of oil of bitter almonds), and dissolve the sugar in the water; mix the two solutions, tint with a little red coloring, and filter clear.

Ratafia.

Originally a liqueur drunk at the ratification of an agreement or treaty. It is now the common generic name in France of liqueurs compounded of spirit, sugar, and the odoriferous and flavoring principles of vegetables, more particularly of those containing the juices of recent fruits, or the kernels of apricots, cherries or peaches. In its restricted sense this name is commonly understood as referring to cherry brandy or peach brandy.

The following list includes those ratafias which are commonly prepared by the French liqueurists:

1.—*Ratafia de Cacao.*—Ratafia de Chocolat.—From Caracca cacao nuts, 1 lb.; West Indian cacao nuts, ½ lb., both roasted and bruised; proof spirit, 1 gal.; digest for 14 days, filter, and add, of white sugar, 2½ lb.; tincture of vanilla, ½ dr. (or a shred of vanilla may be infused with the nuts in the spirit instead); lastly, decant in a month, and bottle it.

2.—*Ratafia de Cafe.*—From coffee, ground and roasted, 1 lb.; brandy or proof spirit, 1 gal.; sugar, 2 lb., dissolved in 1 qt. water, as last.

3.—*Ratafia de Creme.*—From creme de noyeau and sherry, of each ¼ pt.; syrup, ½ pt.; fresh cream, 1 pt.; beaten together.

4.—*Ratafia de Framboises.*—Raspberry Cordial.—To 1¼ lb. of raspberry juice add ¼ lb. of cherry juice; boil this with 2 lb. of sugar; add 4 pt. of brandy, and let it macerate for a fortnight; filter.

5.—*Ratafia de Noyeau.*—From peach or apricot kernels, bruised, 120 in number; proof spirit or brandy, 2 qt.; white sugar, 1 lb.; digest for a week, press and filter.

6.—*Ratafia de Fleurs d'Orange.*—From fresh orange petals, 2 lb.; proof spirit, 1 gal.; white sugar, 2½ lb., as last. Instead of orange flowers 1 dr. oil of neroli may be used.

7.—*Ratafia a la Violette.*—From orris powder, 3 oz.; litmus, 4 oz.; rectified spirit, 2 gal.; digest for 10 days, strain, and add of white sugar, 12 lb., dissolved in 1 gal. soft water.

Rhubarb Cordial.

Rinse gently 40 lb. best quality of rhubarb stalks in a 15 or 20.-gal. tub; add 4 gal. water, stir, and squeeze the pulp with the hands so as to separate the juice. Let it rest for a few hours, strain, and press through a coarse cloth. The residue may have 1 gal. more of water pressed through it. Add 30 lb. loaf sugar, and, after its solution, water to make it up to 10½ gal. Put in a tub covered with a blanket and some boards, at 55 to 60° F., until it begins to ferment. Then put into a cask a portion of the time, as its working decreases until all is in. Let the scum as it works run out of the bung hole. When nearly through fermenting drive the bung, put in a spile, which is to be removed every few days until the barrel is safe from bursting. Use more or less sugar according to the strength and sweetness desired.

Rose.

1.—Extract of rose, 1 oz.; syrup, 2 qt.; rectified spirit, 3 qt.

2.—Rose leaves, 8¾ oz.; orange-flower water, 4 pt.; Ceylon cinnamon, 124 grams; cloves, 1 oz.; macerate the rose leaves, cinnamon and cloves in 17½ pt. spirit, and distil; and to the distillate add 15 oz. of sugar dissolved in 4 pt. of orange-flower water.

3.—Essence of anise, 2.50 grams; essence of fennel, 0.30 gram; essence of bitter almonds, 3 grams; essence of roses, 0.60 gram; essence of ambergris, 0.40 gram; color with cochineal.

4.—Oil of rose, very best, 3 drops; palmarosa oil, 3 drops; sugar, 28 oz.; alcohol, 52 oz.; distilled water, q. s., 8 pt. Dissolve the sugar in the water and the oils in the alcohol, mix the solutions, and color a rosy tint, and filter.

Strawberry Cordial.

1.—Proof spirit, 6¼ gal.; strawberries, 10 qt.; digest for 10 days, and draw off; add soft water, 3¾ gal.; simple syrup, 2½ gal.; agitate, and color if desired.

2.—Juice of fresh strawberries, 1½ pt.; syrup, 3 qt.; rectified spirit, 3 qt.; color with liquid carmine, q. s.

Trappistine.

Large absinthe, 40 grams; angelica, 40 grams; mint, 80 grams; cardamom, 40 grams; balm, 30 grams; myrrh, 20 grams; calamus, 20 grams; cinnamon, 4 grams; cloves, 4 grams; mace, 2 grams; alcohol at 85°, 4.5 l.; white sugar, 3.750 k. Follow the method given for chartreuse. After two days of maceration, distil and rectify. Add syrup, and color green or yellow.

Usquebaugh.

Escubac. Literally, mad water, the Irish name of which whisky is a corruption. It is applied to a strong cordial spirit, much drank in Ireland, and made in the greatest perfection at Drogheda.

1.—Brandy or proof spirit, 3 gal.; dates without their kernels, and raisins, of each, bruised, ¼ lb.; juniper berries, bruised, 1 oz.; mace and cloves, of each ¾ oz.; coriander and aniseed, of each ½ oz.; cinnamon, ¼ oz.; macerate, with frequent agitation, for 14 days, then filter, and add 1 gal. simple syrup.

2.—Pimento and caraways, of each 3 oz.; mace, cloves and nutmegs, of each 2 oz.; aniseed, coriander and angelica root, of each 8 oz.; raisins, stoned and bruised, 14 lb.; proof spirit, 9 gal.; digest as before, then press, filter or clarify, and add of simple syrup, q. s. Should it turn milky, add a little strong spirit, or clarify it with alum, or filter through magnesia.

Usquebaugh is either colored yellow with saffron (about ¼ oz. pe rgal.), or green with sap green (about ½ oz. per gal.); either being added to the other ingredients before maceration in the spirit.

Vanilla Cordial.

Put 1¼ oz. of vanilla beans in 3 qt. alcohol and 1½ gal. water. Macerate for a few days, then distil. Add to this 11 lb. of sugar. After it is dissolved color with cochineal, and filter.

Vanilla Liqueur.—Two sticks of vanilla, 3 pt. of brandy or proof gin, 1 lb. of sugar. Break up the vanilla into the spirit, cork, and let it infuse a fortnight. Boil the sugar in a quart of water to a clear syrup, then pour in the spirit and vanilla, and simmer 10 minutes. Filter, and bottle.

Vermouth.

1.—As the celebrated Vermouth de Turin cannot be made in this country to advantage, the receipt of Ollivero is given. Coriander, 500 grams; rinds of bitter oranges, 250 grams; powdered orris root, 250 grams; elder flowers, 200 grams; red cinchona, 150 grams; calamus, 150 grams; large absinthe, 125 grams; holy thistle (*Centaurea benedicto*), 125 grams; elecampane (roots), 125 grams; little centuary, 125 grams; germander, 125 grams; Chinese cinnamon, 100 grams; angelica (roots), 65 grams; nutmegs, 50 grams; galangal, 50 grams; cloves, 50 grams; cassiae, 30 grams; white wine of Picardy, 100 l. Digest for 5 or 6 days, draw off the liquor, size with fish glue, and allow to stand for fifteen days.

2.—*Vermouth au Madere.*—Large absinthe, 125 grams; angelica roots, 60 grams; holy thistle, 125 grams; burgwort, 125 grams; veronica, 125 grams; rosemary, 125 grams; rhubarb, 30 grams; red cinchona, 200 grams; orris root, powdered, 250 grams; infusion of curacoa, 25 cl.; common Madeira wine, 92 l.; raisin syrup, 3 l.; cognac at 40°, 5 l. Digest for 3 days, draw off the clear, size with fish sounds; after 8 days of rest, rock, and size again before bottling.

Vespetro (by Essences).

Essence of anise, 3 grams; essence of caraway, 2 grams; essence of fennel, 0.60 gram; essence of coriander, 0.80 gram; essence of lemon, distilled, 1 gram; alcohol at 85°, 2.80 l.; water, 6.60 l.; sugar, 2.50 k.

Whisky.

1.—*Bourbon, Imitation of.*—a.—Proof spirit, 9 gal.; Bourbon, highly flavored, 1 gal.; malt whisky, 1 qt.; white vinegar, 1 gill; syrup, 1 gill; cognac oil, dissolved in alcohol, 10 to 20 minims; color with the aid of caramel.

b.—Rectified whisky, 40 gal.; Bourbon oil, dissolved in 1 pt. 86% alcohol, 1¼ oz.; white sugar syrup, 1 pt.

2.—*Irish.*—Rectified whisky, 40 gal.; Irish whisky oil, dissolved in 1 pt. 88% alcohol, 4 to 6 oz.; double refined glycerine, 1 lb.

3.—*Monongahela.*—Rectified whisky, 40 gal.; Monongahela oil, dissolved in 1 pt. 88% alcohol, 1¼ oz.; white sugar, 1 pt.

4.—*Rye.*—Rectified whisky, 40 gal.; rye oil, dissolved in 1 pt. 88% alcohol, 1¼ oz.; white sugar syrup, 1 pt.

5.—*Scotch.*—Rectified whisky, 40 gal; Scotch whisky oil, dissolved in 1 pt. 88% alcohol, 4 to 6 oz.; double refined glycerine, 1 lb.

6.—*Wheat.*—Rectified whisky, 40 gal.; wheat whisky oil, dissolved in 1 pt. 88% alcohol, 1¼ oz.; malt oil, ½ oz.; double refined glycerine, 1 lb.

MIXED DRINKS

Apple Champagne Syrup.

Apple syrup, 3 pt.; pear syrup, 3 pt.; Johannisberger wine, 20 oz.; cognac brandy, 8 oz.; citric acid solution (10%), 1 oz.; ginger essence, soluble, 1 oz.; safflower tincture, 6½ dr.; mucilage of acacia, 5 dr.; apple ether essence, 1 dr.

Apple Toddy.

Hot soda mug. Sugar, ½ tablespoonful; baked apple, ½; applejack, 1 wineglass; fill balance with hot water; mix well, using a spoon; grate nutmeg on top.

Bishop.

1.—Port or sherry, 1 bottle; lemons, 2; loaf sugar, 2 oz.; water, 1 tumbler; spice to taste. Stick 1 lemon with cloves, and roast or bake it; boil the spice in the water, boil up the wine, take off some of the spirit with a lighted paper, add the water and the roasted lemon, and let the preparation stand near the fire for a few minutes. Rub the sugar on the rind of the other lemon, put it into a bowl, strain, and add half the juice of the lemon; pour in he wine, and serve as hot as possible.

2.—To 2 bottles of claret add ¼ lb. of loaf sugar, the thin yellow rind of an orange, and 6 cloves; make all hot, but do not allow it to boil; then strain it through a hair sieve into a bowl and ice.

Blackberry Beverage.

To each lb. of fruit allow 1 lb. of loaf or preserving sugar and 1 tablespoonful of cold water; brandy. Place the fruit, sugar and water in a large jar with a close-fitting cover, stand the jar in a saucepan of boiling water, and cook gently for 2 hours. Strain the juice, measure it, put it into a preserving pan or stewpan (preferably an enameled one), and boil gently for 20 minutes, skimming carefully meanwhile. To each pint of syrup add a small glass of brandy; let the whole become quite cold, then bottle for use.

Brandy Mint Julep.

Brandy, 1 wineglass; sugar, 1 lump; fresh mint, 1 or 2 small sprigs; orange, 1 thin slice; pineapple, 1 thin slice; crushed ice. Put the lump of sugar into a glass, and dissolve it in a few drops of cold water; add the brandy, mint, and a little crushed ice. On the top place a small piece of orange and a small piece of pineapple, and serve.

Note.—Gin or whisky mint julep may be made by substituting these spirits for the brandy.

Brandy Smash.

Water, 1 tablespoon; white sugar, ½ tablespoon; brandy, 1 wineglass; fill the tumbler two-thirds full of shaved ice, put in 2 sprigs of mint; put 2 small pieces of orange on top.

Catawba Syrup.

1.—Simple syrup, 1 pt.; catawba wine, 1 pt.

2.—Catawba wine, 2 qt.; citric acid, 2 oz.; simple syrup, 2 gal.

Champagne.

1.—Rhine wine, 2 pt.; brandy, 2 oz.; sherry, 1 oz.; granulated sugar, 3 lb. Dissolve the sugar without heat.

2.—Rhine wine (Bodenheimer or Laubenheimer), 2 qt.; cognac, 4 oz.; sherry, 2 oz.; granulated sugar, 6 lb. Dissolve the sugar in the wine without heat.

3.—*Phosphate.*—Champagne syrup, 1 oz.; phosphate, three dashes; orange cider, 2 oz.; add a dash of cream, and stir while filling with hot soda.

Cherry Bounce.

1.—To 6 gal. cherry juice add: 80% spirit, 15 gal.; Catalonia or Marseilles wine, 15 gal.; essence noyeau, 1½ oz.; cinnamon, ground, and infused in ¼ gal. of water, ¼ lb.; cloves, ground, and infused in ¼ gal. of water, ¼ lb.; mace, infused in ½ pt. 95% alcohol, ¾ oz. Mix all the above ingredients in a clean barrel, and add 30 gal. sugar syrup, 13° Reaumur. Stir up all the ingredients well together, and filter after 4 or 5 days. Make the color a little darker with sugar coloring, and to give a good shade add a little archil.

2.—Cherries, 12 lb.; to each gal. of juice obtained from them allow 4 lb. of sugar; ground mace, ½ teaspoonful; ground allspice, ¼ teaspoonful; brandy, 1 qt.; rum, 1 qt. Remove the stones, place the fruit in a large jar, and stand the jar in a saucepan containing boiling water. Cook gently until all the juice is extracted, strain it, and measure it into a preserving pan. Add sugar, mace and allspice in the proportions stated above, and simmer the ingredients until the scum ceases to rise. When cold add the spirits, and bottle for use.

Claret.

1.—To 1 qt. of orangeade add a bottle of claret, and freeze as for iced coffee.

2.—Make same as egg phosphate, only use claret syrup. One ounce of the wine may be added if desired.

3.—Make an egg phosphate in the usual maner, and add 1 tablespoonful of claret before serving.

4.—Use claret concentrated syrup, diluting 1 qt. concentrated syrup with 3 qt. plain syrup. Put into a phosphate glass 1½ oz. fountain syrup, add a dash of phosphate, draw soda of sufficient quantity into another glass, pour into glass that contains the syrup, and serve. Claret is a flavor that lends itself specially well to blends and mixtures, like claret mint, claret lemonade, claret pineapple, etc.

Coca.

1.—Coca wine, 1 oz.; calisaya elixir, 1 oz.; orange syrup, 6 oz.

2.—Coca wine, 1 oz.; orange syrup, 3 oz.

3.—Fluid extract coca, 2 oz.; fuller's earth, ½ oz. Mix, then add: Claret wine, 24 oz.; port wine, 4 oz.; simple syrup, 3 oz. Mix, and filter.

4.—*Cognac.*—Wine of coca, 1 pt.; pure cognac brandy, 8 oz.; strong extract of vanilla, 2 oz.; strong extract of rose, 1 oz.; cane sugar or rock candy syrup, enough to make 1 gal.

5.—*Hock.*—Wine of coca, 1 pt.; old hock wine, 2 pt.; cane sugar or rock candy syrup, 5 pt.

Coffee.

Coffee syrup, 2 oz.; brandy, 4 dr.; cream, 2 oz.; 1 egg.

Cups.

Apple.—Slice 3 or 4 large apples, without paring, barely cover them with boiling water, and let the water stand covered until cold. Strain, add 1 pt. of cider, sweeten to taste, pour over crushed ice, and serve.

Bacchus.—Champagne, ½ bottle; sherry, ½ pt.; brandy, ⅛ pt.; noyeau, 1 liqueur glass; castor sugar, 1 tablespoonful; seltzer or soda water, 1 bottle; a few balm leaves; ice. Put the champagne, sherry, brandy, noyeau, sugar and balm leaves into a jug, let it stand for a few minutes, then add a few pieces of ice and the mineral water, and serve at once.

Burgundy.—Burgundy, 1 bottle; port, ½ bottle; soda water, 2 bottles; chartreuse, 1 liqueur glass; juice of 2 oranges; juice of 1 lemon; a few thin slices of cucumber; 1 or 2 sprigs of fresh lemon thyme; 1 tablespoonful of castor sugar. Put all the ingredients, except the port wine, into a large glass jug, surround it with rough pieces of ice, cover closely, and let it remain thus for 1 hour. Just before serving add the port wine

Champagne.—Champagne, 1 bottle; brandy, 1 liqueur glass; seltzer or soda water, 2 bottles; Maraschino, ½ teaspoonful; a few fine strips of lemon peel. When the time permits, it is much better to ice the liquor which forms the basis of a "cooling cup" than to reduce the temperature by adding crushed ice. Place the champagne and seltzer water in a deep vessel, surround them with ice, cover them with a wet woolen cloth, and let them remain for 1 hour. When ready to serve, put the strips of lemon rind into a large glass jug, add the Maraschino and liqueur brandy, pour in the soda water, and serve at once.

2.—Parisian.—Champagne, 1 bottle; seltzer water, 2 bottles; Swiss absinthe, 1 tablespoonful; lump sugar, 1 dessertspoonful; cucumber, a few thin slices; verbena, 2 or 3 sprigs, when procurable. Cool the champagne and seltzer water as directed in the preceding recipe. Place the rest of the ingredients in a large glass jug, and when ready to serve add the iced champagne and seltzer water.

Cider.—Cider, 1 bottle; soda water, 1 bottle; brandy, 1 liqueur glass; cucumber and lemon rind, a few thin strips; lemon juice, a dessertspoonful; castor sugar, 1 dessertspoonful, or to taste. Surround the cider and soda water with rough ice, and let them cool for half an hour. Put the brandy, cucumber and lemon rind, lemon juice and sugar into a large jug, add the iced cider and soda water, and serve at once.

Claret.—1.—Claret, 1 bottle; sherry, 1 wineglassful; brandy, noyeau and Maraschino, each, 1 wineglassful; thin rind of 1 lemon; 2 or 3 sprigs of mint; castor sugar, to taste; seltzer or soda water, 1 large bottle. Put the claret, lemon rind, and 1 or 2 tablespoonfuls of castor sugar into a large jug, cover, and let it stand imbedded in ice for 1 hour. Add the rest of the ingredients, and serve. A few strips of cucumber peel may be used instead of mint.

2.—Put 1 bottle of claret into a glass jug, add a few thin strips of lemon and cucumber rind, cover, and let the jug stand imbedded in ice for 1 hour. Before serving, add 2 glasses of Curacoa and 1 bottle of soda water, and sweeten to taste.

3.—Claret, 1 bottle; soda water, 1 bottle; iced water, ½ tumblerful; ½ lemon, sliced; put in small lumps of ice, and sweeten with sugar. Or claret and champagne cup: claret or champagne, 1 bottle; sherry, 1 large wineglassful; seltzer water, ½ tumblerful; balm and borage; peel of lemon, very thin; 1 slice of cucumber, to be sweetened to taste and highly iced.

Hock.—1.—Hock, 1 bottle; old brandy, 1 liqueur-glassful; Curacoa or Benedictine, ½ liqueur-glassful; seltzer or soda water, 2 bottles; few strips of lemon peel; a little borage. Stand the wine, seltzer or soda water in a deep vessel, surround them with rough ice, and let them remain for an hour. Have the rest of the ingredients ready, in a glass jug, pour in the wine, add the mineral water, and serve at once.

2.—Hock, 1 bottle; seltzer or soda water, 1 bottle; Curacoa, 1 glassful; lemon juice, 1 tablespoonful; lemon rind, a few fine strips; cucumber rind, a few fine strips; castor sugar, a teaspoonful, or to taste. Put all these ingredients, except the mineral water, into a glass jug, surround it with ice, cover closely, and let it remain for half an hour. Just before serving add the mineral water, wihch must previously be iced.

Loving Cup.—Champagne, 1 bottle; Madeira, ½ bottle; French brandy, ¼ pt.; water, 1½ pt.; loaf sugar, ¼ lb.; lemons, 2; balm, a few leaves; borage, 2 or 3 sprigs. Rub the peel off one lemon with some lumps of sugar, then remove every particle of pith, also the rind and pith of the other lemon, and slice them thinly. Put the balm, borage, the sliced lemons and all the sugar into a jug, add the water, Madeira and brandy, cover, surround with ice, and let the mixture remain thus for about 1 hour. Also surround the champagne with ice, and add it to the rest of the ingredients when ready to serve.

Moselle.—Moselle, 1 bottle; Curacoa, 2 glassfuls; seltzer or soda water, 1 bottle; the juice and thin rind of 1 lemon; a few thin slices of cucumber; castor sugar, 1 tablespoonful, or to taste; crushed ice. Put the lemon rind and lemon juice, the sugar, cucumber, Curacoa and wine into a jug, let it stand, covered, for 15 or 20 minutes, then add the mineral water and a little crushed ice, and serve at once.

Sauterne.—Sauterne, 1 qt. bottle; apollinaris, 1 pt. bottle; brandy, 1 wineglassful; Curacoa, 1 wineglassful; juice of 1 lemon; 1 lemon, thinly sliced; 1 orange, thinly sliced; cucumber rind, 2 pieces; mint, a few small sprigs; crushed ice. Put all the above mentioned ingredients, except the mint and ice, into a large glass jug, surround it with ice, and let it stand for 1 hour. Serve with small sprigs of mint floating on the top. If liked, a little castor sugar may be added, and, if more convenient, the cup may be cooled by adding 2 or 3 tablespoonfuls of crushed ice, instead of surrounding it with ice.

Wine.—Champagne (iced), 1 pt.; good claret, 1 pt.; apollinaris, 1 pt.; brandy, 1 wineglassful; Curacoa, 1 wineglassful; orange, sliced, 1; lemon, sliced, 1; cucumber rind, 2 pieces; green mint; ice. Put all these ingredients into a large glass jug, adding 2 or 3 tablespoonfuls of crushed ice. If liked, a little castor sugar may be added. The cup is served with small sprigs of mint floating on its surface.

Zeltlinger Cup.—Zeltlinger, 1 bottle; sherry or brandy, 1 glassful; soda or seltzer water, 1 bottle; fresh or preserved pineapple, cut into sections, 3 or 4 slices; lemon (the juice and thin rind), 1; castor sugar, 1 dessertspoonful, or to taste; ice. Strain the lemon juice into a large glass jug, add the sugar, lemon rind, pineapple, wine, a few lumps of ice, and lastly the soda water. Serve at once.

Egg Flip.

Beer, 1 pt.; eggs, 5; sugar 2 oz.; nutmeg and ginger, sufficient. Break the eggs into half of the beer, add the sugar, and beat well together; then place it in a clean warmer and heat it over the fire to nearly the boiling point, stirring it all the time; but do not let it boil. Next add the other portion of the beer and the spices, and mix well together. Some persons add a glassful of spirits. Care must be taken not to let it boil, as if it does the eggs will separate.

Egg Nog.

1.—Take the yolks of 8 eggs, and beat with them 6 large spoonfuls of pulverized loaf sugar; when this is a cream add the third part of a nutmeg, grated; into this stir 1 tumblerful of good brandy and a wineglassful of good Madeira wine; mix them well together; have ready the whites of the eggs, beaten to a stiff froth, and beat them into the mixture; when all are well mixed add 3 pt. of rich milk.

2.—Put 1 tablespoonful of sherry or brandy into a tumbler, add 1 tablespoonfull of cream and a little sugar, and mix well. Whisk the white of 1 egg to a stiff froth, stir it lightly into the contents of the tumbler, and serve.

3.—Beat 1 egg in a cup, add 1 tablespoonful of brandy and 1 small teaspoonful of castor sugar, and mix well. Strain into a tumbler, stir in 1-3 pt. of milk, and serve.

4.—*Hot.*—a.—Beat the yolk of 1 egg and 1 tablespoonful of castor sugar well together, then stir in 1 tablespoonful of brandy or whisky. Bring 1 pt. of milk to boiling point, then pour it over the mixed ingredients, stir well, and serve.

b.—Plain syrup, ¾ oz.; brandy, ½ oz.; whisky, ¾ oz.; Angostura bitters, 3 drops; 1 egg Put in shaker and beat well. Strain in 10-oz. mug and fill with hot milk; finish with whipped cream and nutmeg.

c.—Break fresh egg into shaker. Shake well, and pour into 5-oz. bouillon cup. Add dashes of whisky and sherry and 1 teaspoonful of sugar. Sprinkle a little cinnamon before drawing hot milk. Serve with two 5 o'clock tea cakes.

d.—Plain syrup, ¾ oz.; brandy, ½ oz.; Angostura bitters, 3 drops; 1 egg. Put in shaker and beat well. Strain in 10-oz. mug and fill with hot milk; finish with whipped cream and nutmeg.

Gin.

Cocktail.—Good unsweetened gin, 1 wineglassful; rock-candy syrup, 10 drops; orange bitters, 10 drops; lemon peel, small piece; crushed ice. Half fill a tumbler with small pieces of ice, pour over it the gin, add the syrup and bitters, then cover and shake well. Strain into a small glass, place a small piece of lemon peel on the top, and serve.

Rickey.—Gin, 1 wineglassful; lemon or lime juice, 1 dessertspoonful; seltzer water; ice. Place a small block of ice at the bottom of a deep champagne glass, strain over it the lemon juice, add the gin, fill up with seltzer water, and serve.

Note.—Any other spirit may be used instead of gin, and would, of course, give its name to the compound. Use fresh limes in season

Golden Fizz.

Claret syrup, 2 oz.; Holland gin, ¼ oz.; lemon juice, 8 dashes; yolk of 1 egg.

John Collins.

Gin, 1 glassful; soda water, iced, 1 bottle; sugar, 1 level teaspoonful; lemon juice, 1 tablespoonful; lemon, 2 or 3 thin slices; crushed ice. Half fill a tumbler with ice, pour over it the gin and lemon juice, add the sugar, cover with a small plate, and shake well. Strain into another tumbler, add the soda water, 1 tablespoonful of crushed ice, and the sliced lemon, then serve.

Kola.

1.—Fluid extract kola, 1 fl.oz.; elixir coca, 2 fl.oz.; extract vanilla, 2 fl.dr.; essence rose, 2 fl.dr.; essence cinnamon, 2 fl.dr.; syrup, to make 2 pt.

2.—Powdered kola, 2 oz.; glycerine, 14 fl.dr.; alcohol, 10 fl.dr.; cinnamon water, 6 fl.oz.; essence vanilla, 1 fl.dr.; tincture orange, 1 fl.oz.; syrup, 5 fl.oz. Macerate for a week, and then filter.

3.—Kola nuts, roasted, 1 oz.; essence vanilla, 1 dr.; syrup, 2 oz.; sherry wine, to make 1 pt.

4.—Roasted kola, No. 20, powdered, 1 part; sherry wine, 50 parts. Mecerate for a week, express, and after allowing the product to stand several days, filter. If a sweet wine is desired, replace 2 parts of the sherry wine by the same quantity of sugar. It is preferable to employ detannated sherry wine, for the reason that the tannin contained in ordinary sherry wine is apt to gradually precipitate the proximate principles of the kola in the finished wine; and thus the latter is likely to become progressively weaker with age.

5.—Shaved ice, ¼ glassful; kola wine, calisaya elixir, ginger ale syrup, of each ½ oz.; liquid phosphate, there dashes;

plain soda, 1 glassful, using both streams. Stir, and serve.

Manhattan Cocktail.

Vermouth, ½ wineglassful; whisky, ½ wineglassful; simple syrup, 30 drops; Angostura bitters, 10 drops; Curacoa 6 drops; a little shaved ice; lemon peel, 1 small strip. Put all the ingredients, except the lemon rind, into a large tumbler, cover the top closely, shake well, and strain into a wineglass. Place the strip of lemon peel on the top, and serve.

Martini Cocktail.

Good, unsweetened gin, ½ wineglassful; Italian vermouth, ½ wineglassful; rock-candy syrup, 6 drops; orange bitters, 12 drops; lemon peel, 1 small piece; crushed ice. Half fill a tumbler with crushed ice, pour over it all the liquids, shake well, then strain into a glass, and serve with a small piece of lemon peel floating on the surface.

Note.—For dry cocktails use French vermouth, and be sparing of bitters.

May Drink.

Hock, or other white wine, 1 bottle; water, ½ pt.; castor sugar, 1 or 2 tablespoonfuls; lemon (the juice and thin rind), 1; black currant leaves, a small handful; woodruff, a few sprigs; crushed ice. Put the sugar, lemon rind and lemon juice, black currant leaves and woodruff into a jug, add the water and wine, and let it stand, covered, and surrounded with ice, for at least ½ hour. Strain into a glass jug, add a few sprigs of mint, then serve.

Metheglin.

From honey, 1 cwt.; warm water, 24 gal.; stir well until dissolved; the next day add of yeast, 1 pt., and hops, 1 lb., previously boiled in 1 gal. of water, along with water, q. s. to make the whole measure 1 bbl.; mix well, and ferment the whole with the usual precautions adopted for other liquors. It contains, on the average, from 7 to 8% alcohol.

Mint Julep.

1.—This is made precisely in the same manner as sherry cobbler, except that you us brandy instead of wine, and you add to your fruits 3 or 4 sprigs of fresh spearmint. Decorate the top with sprigs of mint instead of flowers.

2.—Loaf sugar, 4 cubes; extract mint, 10 drops; prepared milk, 1 dessertspoonful; hot soda, sufficient to fill cup; whipped cream, 1 tablespoonful; grated nutmeg, q. s.

3.—Make a syrup of 1 qt. of water and 1 lb. of sugar. Break up 1 doz. sprigs of mint and soak them in 1½ cupfuls of boiling water, in a covered bowl, for 5 minutes. Then strain, and add the flavored water to the syrup. Turn in the juice of 8 oranges, 8 lemons, ½ pt. of strawberry juice and 1 pt. of claret. Serve with ice in the punch bowl, adding enough ice-water to dilute properly. Fresh mint leaves and berries should float on top of the bowl and in the individual cups.

Mulled Ale.

Good ale, 1 qt.; rum or brandy, 1 glassful; castor sugar, 1 tablespoonful; ground cloves, a pinch; grated nutmeg, a pinch; ground ginger, a good pinch. Put the ale, sugar, cloves, nutmeg and ginger into an ale warmer or stewpan, and bring nearly to boiling point. Add the brandy, and more sugar and flavoring, if necessary, and serve at once.

Mulled Claret.

Heat 1 pt. of claret nearly to boiling point, add ½ pt. of boiling water, sugar, nutmeg and cinnamon to taste, and serve hot. Any kind of wine may be mulled, but port and claret are those usually selected for the purpose.

Negus.

Port wine, ½ pt.; boiling water, ½ pt.; lemon, 2 or 3 thin slices; sugar and nutmeg to taste. Heat the wine in a stewpan, but do not allow it to boil. Put the slices of lemon, a pinch of nutmeg, and 4 or 5 lumps of sugar, into a jug, pour in the boiling water, stir gently until the sugar is dissolved, then add the hot wine, and serve at once.

Perry.

A fermented liquid, prepared from pears, in the same way as cider is from apples. The reduced pulp must not be allowed to remain long without being pressed. In the cask, perry does not bear changes of temperature so well as cider. It is, therefore, advisable, if at the end of the succeeding summer it be in sound condition, to bottle it, when it will keep perfectly well. The red, rough-tasted sorts of pears are principally used for making perry. They should be quite ripe, without, however, approaching to mellowness or decay. The best perry contains about 9% of absolute alcohol; ordinary perry, from 5 to 7%. Perry is a very pleasant-tasted and wholesome liquid. When bottled, champagne fashion, it is said to frequently pass for champagne without the fraud being suspected.

Pineapple Julep.

Pineapple, either fresh or preserved, 1; sparkling Moselle, 1 bottle; gin, 1 gill; raspberry syrup, 1 gill; Maraschino, ⅛ gill; oranges (juice of), 2; crushed ice, 1 lb. Slice the pineapple rather thinly, and divide each slice into 8 sections. Put all the liquids into a glass jug or bowl, add the ice and prepared pineapple, and serve.

Purl.

Prep. To warm ale or beer add bitters, 1 glassful, or q.s. Some add spirit.

Sangaree.

One-third of wine in water, with sugar and nutmeg to the taste.

Frozen.—Nothing can be more refreshing at the dinner table in hot weather than claret or port wine made into sangaree, with proportions of water, sugar and nutmeg as taste shall direct, then frozen, with the addition of a few whites of egg, beaten to a froth. Send to table exactly as you would Roman punch.

Shandy Gaff.

Equal quantities of cold ale or beer and imported ginger ale. Empty the bottles into a jug in which some lumps of ice have been broken, and serve when quite cold.

Sherry Cobbler.

1.—Sherry, ¼ pt.; orange juice, 1 teaspoonful; fine white sugar, 1 teaspoonful; crushed ice. Half fill a large tumbler with ice, pour over it the sherry and orange juice, cover, and shake well. Strain into another tumbler containing the sugar, stir well, and serve with straws.

2.—Sherry, ½ pt.; soda water, 1 bottle; Curacoa, 1 glassful; castor sugar, 1 tablespoonful; crushed ice. Dissolve the sugar in the sherry, and add the liqueur and soda. Put the preparation into tumblers; to each add a few small pieces of ice, and serve. Beverages of this description are usually drunk through straws, but it is merely a matter of taste.

3.—Take sugar, 1 tablespoonful; orange, 2 or 3 slices; sherry, 2 wineglassfuls. Fill the tumbler with shaved ice, and shake well.

4.—To 1 pt. good sherry add an equal measure of heavy simple syrup and one lemon cut in very thin slices. Allow the syrup to stand a few hours; strain through a sieve, and bottle for use.

5.—White syrup, 3 pt.; sherry, 1 qt. Add 1 lemon, cut in thin slices. Macerate for 12 hours, and strain.

6..—*Egg Flip.*—Sherry, 1 glassful; 1 egg; castor sugar, 1 teaspoonful, or to taste; nutmeg; crushed ice. Beat the egg well, add the sugar, sherry, and a little crushed ice, shake well until sufficiently cooled, then strain into a small glass, and serve.

Note.—Port wine, or any spirit, may replace the sherry, and the liquor used would, of course, give its name to the "flip."

7.—*Frappe.*—Add 1 pt. of sherry wine to every qt. of lemon water-ice.

Shrub.

Rum, ½ gal.; orange juice, ¾ pt.; lemon juice, ½ pt.; lemons, peel of 2; loaf sugar, 2 lb.; water, 2½ pt. Slice the lemon peel very thinly and put it, with the fruit juice and spirit, in a large covered jar. Let it stand for 2 days, then pour over it the water in which the sugar has been dissolved, take out the lemon peel, and leave it for 12 days before using.

Silver Fizz.

Gin, 1 wineglassful; juice of ½ lemon; white of 1 egg; icing sugar, 1 teaspoonful; carbonate of soda, a pinch; pounded ice. Fill a tumbler 3 parts full with pounded ice, pour over this the gin and lemon juice, then add the white of egg, beaten to a stiff froth. Shake well, then strain into another tumbler containing the icing sugar and carbonate of soda, and serve at once.

Silver Sour.

Lemon juice, 1 dessertspoonful; unsweetened gin, 1 wineglassful; egg, white of 1; castor sugar, 1 teaspoonful; crushed ice. Put the white of an egg into a tumbler, beat it slightly, then add the lemon juice, gin, sugar, and a heaped tablespoonful of crushed ice. Cover, and shake well until sufficiently cooled, then strain into a small glass, and serve.

Sloe Gin.

1.—Half fill clean, dry wine bottles with sloes. Add to each 1 oz. of crushed barley sugar, a little noyeau, or 2 or 3 drops of essence of almonds. Fill the bottles with good unsweetened gin, cork them securely, and allow them to remain in a moderately warm place for 3 months. At the end of this time strain the liquor through fine muslin or filtering paper until quite clear, then bottle it, cork securely, and store for use.

2.—*Cocktail.*—Half fill a tumbler with broken ice, pour over it ½ wineglassful each of sloe gin and unsweetened gin and 10 drops of orange bitters, cover the top of the glass, and shake it well. When sufficiently cooled, strain it into a small glass, and serve with a small piece of lemon peel floating on the top.

Solferino.

Brandy, 1 pt.; simple syrup, 2 pt.

Whisky Cocktail.

Half fill a tumbler with crushed ice, pour over it 1 wineglassful of whisky, 15 drops of rock-candy syrup and 10 drops of Angostura bitters, cover, and shake well, then strain into a small glass. Place a very small piece of lemon peel on the top, and serve.

Note.—Brandy cocktail may be made by substituting a wineglassful of good French brandy for the whisky.

Whisky Sour.

Rock-candy syrup, 1 dessertspoonful; whisky, 1 wineglassful; lemon juice, and pineapple, 1 thin, small piece; crushed ice. Strain 1 dessertspoonful of lemon juice into a tumbler, add 1 dessertspoonful of rosk-candy syrup and 1 wineglassful of whisky, and a heaped tablespoonful of crushed ice, and shake well. Strain into a small glass, and serve with thin slices of orange and pineapple floating on the top.

Note.—Brandy or any other spirit may be substituted for the whisky, the name being changed accordingly.

PUNCH

Punch is a beverage made of various spirituous liquors or wine, hot water, the acid juice of fruits, and sugar. It is considered to be very intoxicating, but this is probably because the spirit, being partly sheathed by the mucilaginous juice and the sugar, its strength does not appear to the taste so great as it really is. Punch, which was almost universally drunk among the middle classes about 50 or 60 years ago, has almost disappeared from our domestic tables, being superseded by wine. There are many different varieties of punch. It is sometimes kept cold in bottles, and makes a most agreeable summer drink.

1.—Lemons, juice of 3 or 4; lemons, yellow peel of 1 or 2; lump sugar, ¾ lb.; boiling water, 3½ pt.; infuse ½ hour, strain, add porter, ½ pt.; rum and brandy, of each ¾ to 1 pt. (or either, alone, 1½ to 2 pt.); and add more warm water and sugar, if desired weaker or sweeter.

2.—Water, 3 pt.; sugar, 1½ lb.; raspberry juice, 1 pt.; lemons, juice of 2; 1 orange; mace, 1 blade; cinnamon, 1 small stick; cloves, 8; claret, 1 pt.; brandy, 1 pt.; French cherries, 3 oz. Put the cherries to soak in a little of the brandy, and afterward cut them in quarters. Crush the spices, and add them and the grated rind of 1 lemon and 1 orange to the sugar and water; boil up once and set aside to cool. Strain the syrup and add the lemon, orange and raspberry juices, then freeze. When partly frozen add the claret and brandy; freeze a few minutes longer, then mix in the cut cherries, and finish. The well whisked whites of 2 eggs may be worked in when the cherries are added, if desired Color pink or very light red.

3.—Brandy, ½ pt.; rum, ½ pt.; boiling water, 1 pt.; loaf sugar, 2 or 3 oz.; 1 large lemon; ground cinnamon, a pinch; grated nutmeg, a pinch. Remove the rind of the lemon by rubbing it with some of the sugar. Put the whole of the sugar, cinnamon, cloves, brandy, rum and boiling water into a stewpan, heat gently by the side of the fire, but do not let it approach boiling point. Strain the lemon juice into a punch bowl, add the hot liquid, and serve at once.

4.—Very old ale, 1 qt.; boiling water, 1 pt.; rum, ¼ pt.; whisky, ¼ pt.; gin, ¼ pt.; 1 lemon, thinly sliced; sugar to taste; ground cinnamon, a pinch; ground cloves, a pinch; grated nutmeg, a pinch. Put all these ingredients into a large stewpan and bring nearly to boiling point. Strain into a punch bowl, add a few fresh thin slices of lemon, and serve.

Arrack Punch, Imitation.

Two or three preserved tamarinds, dissolved in a bowl of any kind of punch, will impart to it a flavor closely resembling arrack.

Brandy.

1.—To 1 pt. cognac brandy, ½ pt. of Jamaica rum, ½ pt. of peach brandy, add 2 lb. white sugar, 1 gill of lemon and 1 gill of lime juice; mix all well together, and add ice equal to 2 qt. of water; cut 2 lemons into thin slices, peel and slice thin 1 pineapple; add these to the punch, and let stand, to ripen and blend, for 1 hour before using.

2.—To 1 teaspoonful of raspberry syrup add 1 tablespoonful of white sugar, 1 wineglassful of brandy, the same quantity of water, a small piece of lemon, 2 slices of orange, 1 piece of pineapple. Fill the tumbler with shaved ice, shake well, and dress the top with berries in season; sip through a straw.

3.—Take 3 doz. lemons, chip off the yellow rinds, taking care that none of the white underlying pith is taken, as that would make the punch bitter, whereas the yellow portion of the rinds is that in which the flavor resides, and in which the cells are placed containing the essential oil. Put this yellow rind into a punch bowl, add to it 2 lb. of lump sugar, stir the sugar and peel together with a wooden spoon or spatula for nearly half an hour, thereby extracting a greater quantity of the essential oil. Now add boiling water, and stir until the sugar is completely dissolved. Squeeze and strain the juice from the lemons and add it to the mixture; stir together and taste it; add more acid or more sugar, as required, and take care not to render it too watery. "Rich of the fruit and plenty of sweetness," is the maxim. Now measure the sherbet, and to every 3 qt. add 1 pt. of cognac brandy and 1 pt. of old Jamaica rum, the spirit being well stirred as poured in. This punch may be bottled, and kept in a cold cellar; it will be found to improve with age.

Burgundy.

Burgundy wine, 2 oz.; orange syrup, 1 oz. Fill a 12-oz. glass with crushed ice, draw coarse stream to fill glass. Decorate with slice each of pineapple and orange. Serve with straws.

Catawba.

Lemon syrup, 1 oz.; juice of half a lemon; Catawba wine, 2 oz.; shaved ice, ¼ glassful. Mix in 14-oz. straight lemonade glass. Decorate with pineapple and cherries.

Chatham Artillery Punch.

Catawba wine, 1 gal.; New England rum, 1 qt.; whisky, 1 qt. Cut up and add 6 pineapples, 12 oranges, and strawberries q. s., and allow to stand or draw one night. When ready to use, 1 doz. qt. bottles of champagne are needed to give tone and bead. A Southern drink, which is *very intoxicating*, and should be avoided.

Cider.

Cider, iced, 1 qt.; seltzer or soda water, iced, 1 bottle; brandy, 1 wineglassful; sugar, 2 oz., or to taste; 1 lemon, thinly sliced. Mix all the ingredients together in a glass jug, and serve in small glasses.

Claret.

1.—To a large punch bowl half filled with broken ice, add 2 lb. of pulverized sugar, 6 oranges cut crosswise into thin slices, 6 bottles of claret, and 1 bottle of champagne; mix well together and let stand for 1 hour before using.

2.—Take 1 tablespoonful of sugar, a small slice of lemon, 2 or 3 slices of orange. Fill the tumbler with shaved ice, and then pour in the claret, shake well, and ornament with berries in season. Place a straw in the glass.

3.—Take 1½ tablespoonfuls of sugar, 1 slice of lemon, 2 or 3 slices of orange. Fill the tumbler with shaved ice, pour in the claret, and shake well.

4.—Claret syrup, ½ oz.; orange, 1 slice; lemon, 1 slice; shaved ice, ¼ glassful. Fill 12-oz. glass with coarse stream, stir, decorate with fruit, and serve with straws.

Cold Punch.

1.—Rum, 1 bottle; Curacoa, 2 small glassfuls; white wine, 1 bottle; powdered sugar, ½ lb.; 1 large lemon; water, ½ pt.; ice. Put the sugar and lemon rind into a bowl with the water; when dissolved, add the spirits, the wine, and the juice of the lemon. Break some ice into the bowl before serving.

2.—Arrack, port wine, water, of each 1 pt.; lemons, juice of 4; sugar, 1 lb.; mix.

Cream Punch.

Pare off the rind of four large lemons, and steep it for 24 hours in 1 qt. brandy or rum; them mix it with the juice of the lemons, 1½ lbs. of sugar, 3½ pt. of boiled water, and about 2-3 of a can of evaporated cream; mix well, and strain the whole through a jelly bag. You may either use it at once, or make a large quantity and bottle it.

East India Punch.

Brandy, ½ pt.; port wine, 1 pt.; syrup, No. 2599, 1 pt.; lime-juice syrup, ½ pt.; seltzer water, iced, 1 bottle; arrack, ½ gill; lemons, the thinly pared rinds of 2; syringa, 2 or 3 sprigs; crushed ice, 1 breakfast-cupful; sugar to taste. Soak the lemon rind in the brandy for 3 hours, then strain, add the rest of the ingredients, and serve.

Gin Punch.

1.—To ½ pt. of old Holland gin add 1 gill of Maraschino, the juice of 2 lemons, and the yellow rind of 1, previously infused in the gin, 2 gills of simple syrup or 4 oz. of pulverized sugar, and 1 qt. of seltzer water. Mix well, and freeze to a semi-solid.

2.—Lemon, yellow peel and juice of 1; gin, ¾ pt.; water, 1¾ pt.; sherry, 1 glassful.

Hot Punch.

Rum, ½ pt.; brandy, ½ pt.; sugar, ¼ lb.; 1 large lemon; nutmeg, ½ teaspoonful; boiling water, 1 pt. Rub the sugar over the lemon until it has absorbed all the yellow part of the skin; then put the sugar into a punch bowl; add the lemon juice (free from pips), and mix these two ingredients well together. Pour over them the boiling water, stir well together, add the rum, brandy and nutmeg, mix thoroughly, and the punch will be ready to serve. It is very important in making good punch that all the ingredients are thoroughly incorporated; and to insure success, the process of mixing must be diligently attended to.

Iced.

Champagne or Rhenish wine, 1 qt.; arrack, 1 pt.; lemons, juice and yellow peel of 6; white sugar, 1 lb.; soda water, 1 or 2 bottles; ice as cream.

Manhattan.

Powdered sugar, 1 tablespoonful; sweet milk, 2 oz.; 1 egg; vermouth, ¼ oz.; whisky, ¾ oz.; Angostura bitters, 1 dash. Cracked ice to fill glass. Shake well, and strain in 7-oz. goblet. Grate nutmeg on top. Serve with straws.

Maraschino Fruit Punch.

Whole cherries, 1 qt.; Maraschino cordial, 2 oz.; sliced oranges, 8; sliced lemons, 4; pineapple cubes, 8 oz.; brandy, 4 oz.; juice of 6 lemons; juice of 6 oranges; water, 1½ gal. Sweeten and color to suit taste. Mix all ingredients; serve from punch bowl, with the addition of cracked ice.

Milk Punch.

1.—Fill a tumbler about ¼ full of evaporated cream, put in a tablespoonful of powdered sugar, about as much liquor (or sherry, if preferred) as cream, then fill the tumbler with cracked ice and shake well.

2.—Take sugar, 1 tablespoonful; water, 2 tablespoonfuls; brandy, 1 wineglassful; Santa Cruz rum, ½ wineglassful; shaved ice, 1-3 tumblerful. Fill with milk and shake well; grate a little nutmeg on top.

3.—Yellow rinds of 2 doz. lemons; steep for 2 days in rum or brandy, 2 qt.; then add spirit, 3 qt. more; hot water, 3 qt.; lemon juice, 1 qt.; loaf sugar, 4 lb.; 2 nutmegs, grated; boiling milk, 2 qt. Mix and in 2 hours strain through a jelly bag.

4.—*Syrup*.—a.—Simple syrup, 1 pt.; brandy, 8 oz.; Jamaica rum, 8 oz.; cream 1 pt.

b.——To 1 pt. heavy syrup add ½ pt. each of brandy and Jamaica rum; flavor with 2 teaspoonfuls of an extract prepared by macerating 2 oz. of ground nutmegs in 8 oz. of alcohol. The syrup is first to be poured into the glass in the proper quantity and ordinary cream syrup added before drawing the soda water.

c.—Brandy, 4 vol.; Jamaica rum, 4 vol.; condensed milk, 1 vol.; syrup, 8 vol.

d.—Rock-candy syrup, 2 pt.; brandy, 8 oz.; Jamaica rum, 6 oz.; cream, 1½ pt.

Norfolk.

French brandy, 20 qt.; yellow peels of 30 oranges and 30 lemons; infuse for 12 hours; add cold water, 30 qt.; lump sugar, 15 lb., and the juice of the oranges and lemons; mix well, strain through a hair sieve, add new milk, 2 qt., and in 6 weeks bottle. Keeps well.

Orgeat Punch.

Orgeat syrup, 12 dr.; brandy, 1 oz.; juice of 1 lemon.

Princes'.

Put into a freezing can a bottle of sparkling champagne, 1 gill of maraschino, ½ pt. of strawberry syrup, the juice of 6 oranges, the yellow rind of 1 rubbed on sugar.

Raspberry.

As Norfolk, but using raspberry juice or vinegar for oranges or lemons.

Regent's.

Pare off the thin yellow rinds from 4 oranges and 4 lemons; express the juice from the same fruit and strain it; add to it the yellow rinds, with 2 sticks of cinnamon broken up, ½ doz. cloves and a dessertspoonful of vanilla sugar Simmer these ingredients very slowly for ½ hour in 1 qt. of simple syrup. Express the juice from 1½ doz. of lemons and add it to the decoction. Then make a strong infusion of the finest green tea and add it to the mixture. After which add equal portions of old Jamaica rum and cognac brandy, according to the strength required. Mix all well together, strain through a hair sieve, put it into a freezer and make very cold.

Roman.

French brandy, 4 oz.; best Jamaica rum, 4 oz.; extract vanilla, ¼ oz.; fruit acid, ¼ oz.; syrup, 1 gal.

Tea.

1.—Strong hot green tea, lemon juice and capillaire, of each 1½ pt.; rum, brandy, arrack and Curacoa, of each 1 pt.; champagne, 1 bottle. Mix and slice a pineapple into it.

2.—Hot tea, 1 qt.; arrack, ½ bottle; white sugar, 6 oz.; juice of 8 lemons; yellow rinds of 4 lemons.

Wine.

Sugar, 1 lb.; yellow peel of 3 lemons; juice of 9 lemons; arrack, 1 pt.; port or sherry wine, hot, 1 gal.; cinnamon, ¼ oz.; nutmeg, 1 dr.

Whisky.

1.—To 1 wineglassful of whisky add 2 wineglassfuls of hot water and then sugar to taste. Dissolve the sugar well with 1 wineglassful of the water, then pour in the whisky and add the balance of the water; sweeten to taste and put in a small piece of lemon rind or a thin slice of lemon.

2.—Scotch whisky, 1 bottle; boiling water, 1 qt.; loaf sugar, ½ lb.; the juice and finely pared rinds of 3 lemons. Pour the boiling water over the sugar, lemon rinds and juice. Let it remain until cold, then strain into a punch bowl. Add the whisky, place the bowl in a large vessel, surround it with ice, cover and let it stand thus for at least 1 hour before serving.

3.—Whisky, 1 wineglassful; lemon juice, 1 dessertspoonful; castor sugar, 1 teaspoonful; orange, 1 thin slice; pineapple, 1 thin small piece; crushed ice. Put a heaped tablespoonful of crushed ice into a glass, pour over it the whisky and lemon juice, add the sugar and shake well until sufficiently cooled. Strain into a small glass and serve with the orange and pineapple floating on the surface.

WINES AND WINE MAKING

Wine Making.

The grapes are not removed from the vine until they are quite ripe. As the maturation not only of different varieties, but of the same kind, is dependent upon the season, no stated period can be fixed for the commencement of the vintage. The grapes are ready to be gathered when the white kind becomes of a brownish yellow color and the red of blue very drak purple or nearly black. Shears, pruning knives or scissors are used for the removal of the fruit from the vine.

In making the finer wines, previous to being pressed, the bunches are carefully examined, and any unripe or damaged grapes are picked off and used to make inferior wine, or in the gathering the unripe specimens are left on the branch to ripen. The blue and dark varieties, when intended for the best wines, are, with few exceptions, removed from the stalks before being pressed: the white grapes are pressed with the stalks.

Except with those grapes which produce wines that are likely to become viscous or ropy, the stalks are not left for any length of time in contact with the grape juice or must. There are various modes of separating the grapes from the stalks. One method consists in the employment of a wooden fork or trident ½ yd. or more in length. By turning this round in a wooden pail filled with the fruit the grapes become detached from the stalks, which are thus brought to the surface and removed.

In another contrivance the separation is effected by inclosing the bunches in cages made of parrallel wires. Inside the cage there is a stirrer. When this is turned by an external handle the grapes alone drop through the wires, leaving the stalks in the cage. Sometimes the separation is accomplished by means of hurdles, which are so manipulated that the fruit only shall pass through the meshes.

Previous to their being pressed the grapes have to undergo the preliminary process of bruising or crushing. This is sometimes done by their being trodden under the naked feet of men on a large wooden stage or platform; at other times the men wear heavy boots, while in some cases the grapes are placed in a vat and bruised with a kind of wooden pestle. Sometimes they are crushed between wooden grooved rollers. Of all these processes, the first, although the least cleanly, possesses the advantage of not crushing the pips or stalks, and is thus free from the risk of imparting an unpleasant flavor to the wine.

There is considerable divergence in the statements of different writers as to the yield of must or juice from ripe grapes. Payen says it amounts to from 94 to 96% of the total weight of the grape. Dupre and Thudichum obtained from three samples of grapes, respectively, 78.75%, 76.75% and 72.25%. Wagner averages it from about 60 or 70%.

When a white wine is required, the

bruised grape, whether of the white or red variety, is at once pressed, except when, as happens with some kinds of fruit, it is kept to allow of the development of the bouquet. The mode of procedure is different when a red wine is to be prepared. The crushed grapes must then be kept in a tub or vat, loosely covered over, until an examination of a small quantity of the juice shows it has acquired the necessary color. For it to do this sometimes takes from 3 to 4 days to a month.

During this period alcohol has been formed in the pulp, and this, with the tartaric acid of the fruit, has dissolved out the coloring principle of the grape. Great care is necessary at this stage to prevent the too long exposure of the crushed and fermenting fruit to the air.

Wine presses are of various patterns.

In many wine-making establishments iron presses have supplanted wooden ones, over which they possess the advantages of greater cleanliness and non-absorption of the must. The wine press in general use in the Gironde consists of a tall, round basket, made of perpendicular laths. The fruit is placed in this basket, and upon the fruit a wooden block, to which a screw is attached; a nut works upon the screw from above downward and presses the wooden block upon the fruit, the liquid from which is forced out through the laths and collected.

In the manufacture of champagne and some red wines, very powerful presses are employed, but these possess the objection of pressing the fixed oil from the pips and an unpleasantly tasting juice from the stalks, and thereby damaging the product. In some establishments centrifugal machines have been used, not only with the result of yielding a better wine, but of effecting a considerable gain in time and labor.

The must, being received into proper receptacles, next undergoes the vinous fermentation. In the case of white wines the must is kept separate from that subsequently procured by submitting the husks, pips and stalks to additional pressure, and is sold as the first or superior wine. But with red wines the husks (and in some cases the marc) are thrown into the fermenting vat, by which means the wine acquires an additional amount of coloring matter. In this case, when the completed wine is drawn off, the husks are again pressed, and the wine so obtained added to the first instalment. As the tannic acid is derived from the skins and seeds of the grape, wines prepared in this manner usually contain a considerable amount of this substance.

The fermentation is conducted in different countries at different temperatures, and, of course, with different results. When must is fermented at 15 to 20° C. (59 to 68° F.) it yields a wine strong in alcohol, but wanting in bouquet; while if the fermentation be carried on at 5 to 15° C. (41 to 59° F.) the product will be a wine rich in bouquet, but poor in alcohol.

The wines of Spain, the south of France, Austria and Hungary are produced at the higher temperature, and those of Germany, for the most part, at the lower one. The fermentation is carried on in large wooden vats. In some places vats of sandstone or brick are used for this purpose. The fermentation of white wines, such as those of the Rhine and Gironde, is effected in new and perfectly clean casks or hogsheads, the bungholes of which are left open to allow the escape of the carbonic acid. Opinions differ as to whether air should be admitted or not during fermentation. The process is undoubtedly quickened if the must be aerated. The aeration is sometimes performed by a bellows fitted with a rose nozzle. During the operation of blowing in the must is to be kept at a low temperature to prevent the volatilization of the bouquet. When the opposite method is followed various devices are in use for excluding the air, or at any rate an excess of it. In some cases the vat, being provided with a suitable lid, has a hole or is arranged with a tube for the escape of the carbonic acid. Koles and Bamberger accomplish the same end, without letting in the external air, by means of a glass tube bent twice at right angles; one limb of the tube passes through the bunghole into the wine, and the other or outer limb into a vessel of water. In another contrivance the lid of the vat is fitted with a valve, which, opening only outward, allows of the exit of the carbonic acid.

Red wines are fermented in large and, in most cases, open vats, fitted in the inside with perforated shelves, which, being below the surface of the liquid, prevent the husks rising to the top and setting up acetous fermentation. After the completion of the fermentation of Burgundy wines, in some places it is the filthy custom for men to enter the vat and by their vigorous movements to mix the contents. It is satisfactory to learn that this particularly objectionable practice is getting somewhat into disuse.

The length of time necessary for the

completion of the fermentation varies with the locality, the temperature of the apartment and with the quality of the wine required. In France, for the ordinary descriptions of wine, it generally takes from 3 days to 1 week, and in Germany from 1 to 2 weeks. With the finer kinds of wine it occupies 4, 5 or 6 weeks. The progress of the fermentation may be estimated from the specific gravity of the liquid, since as the fermentation proceeds and the sugar is undergoing conversion into alcohol, the wine of course becomes more attenuated and its specific gravity diminishes. It has been calculated that one-half per cent. of the alcohol present in the wine escapes during fermentation, as well as a considerable quantity of carbonic acid. An apparatus has been invented for collecting these products by causing them to pass into water by means of a hydraulic bung.

When the fermentation is over the wine is run into casks, any sediment, such as lees or yeast, being left behind in the fermenting vessel. It is most important that the casks used for this purpose should be absolutely clean. Before a cask is used a second time it should be thoroughly sulphured.

Those wines which contain a large amount of alcohol are sometimes allowed to remain in the fermenting vat until they have cleared, but weak wines are immediately drawn off into the cask to prevent the setting in of the acetous fermentation. The casks must be filled to the bungholes. A second or minor fermentation takes place in the wine when in the cask, during which tartar or bitartrate of potash is deposited on the sides of the cask and yeast at the bottom. This second fermentation should be allowed to go on at a low temperature, 5 to 10° C. (41 to 50° F.), and at a slow rate. In some cases it is made to extend to 3 or 6 months.

When the second fermentation is over the casks are filled to the bunghole and securely closed, or the wine is at once drawn into fresh casks to be stored. In these it remains closely bunged up until more tartar is deposited. after which it may be racked off into bottles or casks. When wine is to be stored for any length of time it is necessary to repeat the racking off frequently. Racking is performed by means of a siphon inserted in the bunghole or by a cock suitably fixed in the cask. If the racked wine is not perfectly clear, it is fined by the addition of isinglass, previously softened by soaking in a small quantity of wine. After the addition of the isinglass the cask is then filled to the bunghole, closed and remains undisturbed for about 6 weeks, and if, at the end of that time, it is not perfectly bright it is made to undergo a second racking. In wine-making countries blood and solution of glue are sometimes used for fining red wines which contain much tannin. Milk is also occasionally employed for the same purpose. The racking should be performed in cool weather and preferably in the early spring.

The manufacture of champagne differs in its details from that of the so-called still wine. The best wine is made from a black grape of very fine quality, known as the *Noirien*, or *Pineau*, and grown in the champagne district. None but the best selected grapes are used; all those that are rotten, unripe or in any way unsound being rejected. The grapes are gathered when they have attained their greatest size. The vintage commences early in October. To prevent the juice being colored by the skin of the grape, the fruit is submitted to pressure as quickly as possible after being gathered. Very powerful machines are employed for this purpose, since the champagne grape, unlike other varieties, is not previously crushed. Great care is taken to apply the pressure evenly and to conduct the operation with all expedition, for if this exceeds 2 hours the must will be colored. The grapes are sometimes pressed 4 times. In good seasons the must obtained from the different pressings is mixed together. In middling ones the first yield is kept for making the best wines, nor is the fourth mixed with the other two. The light-colored must is first conveyed into a large vat, where is remains for 6, 12 or 18 hours, according to the temperature.

At the end of this time certain vegetable matters that would damage the taste of the ensuing wine, as well as render it liable to a second fermentation, become deposited. Directly the must has cleared it is run into small barrels of 2,000 l. capacity, in which it undergoes fermentation. Sometimes the clearing of the juice is accomplished by filtration; at others, when the weather is warm and fermentation sets in so rapidly as not to allow the impurities to subside, it is run into casks filled with the fumes from burning sulphur. By this means the excessive fermentative action is arrested and sufficient time is given for the dregs to settle. The juice having been made clear by either of the above methods is drawn into barrels, which are arranged in rows in the cellars. The barrels are filled to the bung, the froth which is formed during the fermentation flowing out at the bungholes. In some wine-making establishments the barrels are tightly bunged up, there being previously added to the contents 1% of brandy. The casks are opened at the end of December and the wine fined by means of isinglass, this operation being conducted at the lowest possible temperature. It, at the end of a fortnight, it has not become bright, it is left for another fortnight, and then, if not clear, it undergoes a second fining. The fining process must be used with caution; when overdone it diminishes and frequently stops the activity of the subsequent fermentation. To obviate this the wine should be judiciously exposed to the air and a minute quantity of yeast added to each hogshead before it is bottled.

When the wine has cleared, before being bottled, cane sugar is added to it, since the quantity of undecomposed natural sugar in the wine is not sufficient to furnish the requisite amount of carbonic-acid gas, the ingredient to which champagne owes its effervescent properties.

Champagne bottles constitute a very considerable item in the trade expenses of the wine maker. He pays the glass manufacturer 28 francs a hundred for them, and some wine makers give orders for as many as from 50,000 to 250,000 at a time.

The bottles as they arrive are examined by an experienced person, and those which contain flaws of any kind, or are not perfectly new, symmetrical and strong, are rejected. These average about 10%. The bottles are required to be as nearly as possible of uniform weight and thickness. The inside of each bottle is scrubbed by means of a revolving hair brush and clean water. After being drained, the bottles are rinsed with 90% alcohol and closed with an old but clean cork. They are thus ready, when required, for filling. The wine maker also expends a large amount of money in the purchase of corks, which must be of the best and soundest description. It has been found to be very false economy to use inferior kinds. The wine being drawn into bottles to a height of 2 or 3 inches from the top of the neck, the bottles have next to be corked, the cork being secured in the bottle by a small iron band, called an *agrafe*. All these operations have to be performed deftly and rapidly by experienced workmen. With what speed they are accomplished may be imagined from the fact that an *atelier* of 5 workmen, who divide the labor, will bottle and cork from 1,200 to 1,500 bottles daily, 2 bottles passing through all hands in 1 minute. The corking, etc., finished, the bottles are next placed on their sides and stacked in cellars or caves, each stack being supported by thin laths.

As the summer approaches, the wine begins to show signs of fermentation, which increases with the hot weather. When the fermentation reaches such a stage as to cause the wine to occupy the previously unfilled space in the neck of the bottle, a large number of bottles begin to burst, as well as to leak; and in some years as much as 30% of the wine is lost from these causes. Two courses, each of which requires to be promptly adopted, are open to the wine maker under these circumstances. Either he must remove the wine to a cooler cellar or uncork the bottles. Sometimes, if the breakage, or *casse*, as it is termed, has not exceeded 7 or 8% by the time August is reached, he takes the chance of further loss and lets the wine remain, for with the fall in temperature, which usually occurs in September and October, the energetic action of the wine ceases and the brekage also.

The leaky and broken bottles are then removed from the sound ones, which are restacked and left until a yeasty substance has discontinued depositing upon their lower sides. The bottles are kept in this condition until required for sale. Before, however, they are in a fit state for the purchaser, the yeasty matter has to be removed and the wine to be liqueured. The yeast is got rid of as follows: The bottles are placed necks downward, on perforated shelves arranged in rows. A workman then seizes a bottle, and holding it in the inverted position, by a dexterous movement discharges the yeast from the side and brings it down upon the cork. This operation, which extends over some weeks, has to be repeated from time to time, until the supernatant wine is quite clear. The bottles are then very cautiously removed from the cellars to the corking and tying-down rooms, when they come into the hands of a workman called a disgorger. The disgorger, holding the bottle still neck downward, proceeds to liberate the cork by slipping off the *agrafe*, and when the cork is 3 parts out he quickly inverts the bottle. The cork is then forcibly ejected with a loud report by the froth, which carries with it the greater part of the yeast and other solid matters, what remains of these being got rid of by the workman working his finger round the neck of the bottle, whereby they are detached and forced out by the still rising froth. The workman then places his thumb over the mouth of the bottle, which is afterward temporarily closed with an old cork.

The liqueur, which is next to be added, is of very varied composition, as almost every champagne maker has his favorite and special preparation.

The best liqueurs are made of some choice wine, mixed with the purest cane sugar. The inferior kinds consist of a mixture of 90% alcohol, sugar and some flavoring material. A certain measured quantity of the liqueur is added to each bottle of wine. The bottle is then corked, wired, tied down and washed and the cork covered with tinfoil and labeled. It is then ready for sale and export. It sometimes happens htat after the previous round of operations has been gone through the champagne becomes turbid and a minor second fermentation sets in. In this case it is made to undergo a repetition of the processes already described. It is a desideratum with every champagne maker that when the bottle is opened for its contents to be drunk, the removal of the cork should be accompanied with a full, deep and distinct report. When, instead of this, the report is short and sharp and resembles a popping noise, this is owing to the space between the liquid and the cork, filled with the gas, being too small. When the gas escapes with a hissing noise, it is because the cork fits the neck of the bottle unequally or has not been driven in in a perfectly straight direction. The good name of any maker would be seriously damaged were he to send out champagne liable to comport itself in this manner. He therefore spares no expense in providing himself with the very best and soundest corks. The best way to prevent the escape of the gas from the bottle is always to keep the bottles lying on their sides.

All effervescing wines are manufactured in a similar manner to champagne.

Since the alcohol in the wine is derived from the sugar contained in the must, it would seem that the sweetest and ripest grapes should yield the strongest product. When the decomposition of the sugar has been complete, this will be the result; but it frequently happens that, owing to an insufficiency in the must of the protein compounds which nourish the yeast cells (the *torula cerevisiae*), by the agency of which the fermentation is accomplished, the whole of the sugar is not converted into alcohol, in which case a sweet wine will be produced, or the sweetness may be due to the alcohol formed stopping the

Table Showing the Quantity of Alcohol in Wine.

Names, etc.	Alcohol of 0.7937 per cent. by weight.	Proof spirit per cent. by volume.
Port:		
Weakest	14.97	31.31
Mean of 7 samples	16.20	34.91
Strongest	17.10	37.27
White	14.97	31.31
Sherry:		
Weakest	13.98	30.84
Mean of 13 wines, excluding those very long kept in cask	15.37	33.59
Strongest	16.17	35.12
Mean of 9 wines long kept in cask in the East Indies	14.72	31.30
Madre da Xeres	16.90	37.06
Madeira:		
Long kept in cask in the East Indies—strongest	16.90	37.06
Long kept in cask in the East Indies—weakest	14.09	30.86
Teneriffe (long in cask at Calcutta)	13.84	30.21
Cercial	15.45	33.65
Lisbon (dry)	16.14	34.71
Shiraz	12.95	28.30
Amontillado	12.63	27.60
Claret (a first growth of 1811)	7.72	16.95
Chateau-Latour (a first growth of 1825)	7.78	17.06
Rosan (second growth of 1825)	7.61	16.74
Ordinary Claret (Vin Ordinaire)	8.99	18.96
Rivesaltes	9.31	22.35
Malmsley	12.86	28.17
Rudesheimer, first quality	8.40	18.44
Rudesheimer, inferior	6.90	15.19
Hambacher, superior quality	7.35	16.15

fermentation before all the sugar had been decomposed or to an excess of glycerine. If, on the other hand, the grape juice is rich in albuminous matter, but poor in sugar, the consequent wine will be what is termed a dry one. Such are the red wines of France and the Rhine.

According to Wagner, red French wines cotain 9 to 14% by volume of alcohol; Burgundy, 9, 10 and 11%; Bordeaux, 10, 11 and 12%. Other French wines contain 8 to 10%; the wines of the Palatinate, 7 to 9.5%; Hungarian wines, 9 to 11%. Champagne contains 9 to 12%; Xeres, 17%; Madeira, 17 to 23.7%.

In addition to ethylic alcohol and water, which, as shown in the previous table, vary largely in the proportions in which they are present in different kinds of wine, most wines contain the following substances: Propylic, butylic, caprylic and caproic alcohols; acetic and enanthic ether; grape sugar (dextrose and levulose); glycerine; gums; pectin; coloring and fatty substances; protein bodies; carbonic acid, ordinary and levo-tartaric and racenic acids; citric acid; malic acid; tannic acid; acetic acid; lactic acid; succinic acid; organic and inorganic salts.

Of these the propylic and butylic, caprylic and caproic alcohols, the ethers, the glycerine, the carbonic, acetic, lactic and succinic acids are produced during fermentation, the remaining substances being original constituents of the grape juice, which also contains bitartrate of potash, but this being insoluble in weak spirit is thrown down or deposited as the conversion of sugar into alcohol proceeds. In its crude condition it is known as argol and is the source of cream of tartar and tartaric acid. As a result of its formation in the grape a considerable amount of the free acid is removed from the fruit. This is why wine made from grapes is so much superior and keeps so much better than that manufactured from fruits that abound instead in citric and malic acids. These latter require the addition of large quantities of sugar to disguise their acidity, a proceeding which frequently gives rise in them to a second fermentation and often to the consequent formation of acetic acid. The acetic ether in wine is produced by the mutual reaction of acetic acid and ethylic alcohol. Neubauer, dissenting from Dupre and Thudichum, says the enanthic ether is the constituent to which wines owe their bouquet. He regards this ether as a combination of various substances of which caprylic and caproic acid ethers are the most important. Their formation is believed to take place partly during and partly after fermentation. The rest of the non-volatile constituents, such as the sugar, the gum, the protein bodies, coloring matter, inorganic salts, etc., which remain behind when a wine is evaporated to dryness, constitute, with a certain quantity of substance the composition of which has not been defined, the extractive matter.

The amount of extractive matter in wines varies as greatly as from 1 to 20%. This difference occurs even in wines of a similar character and from the same district. Thus in Rhine wines it ranges from 10.6 to 4.2%, in the Palatinate wines from 10.7 to 1.9%, in Bohemian wines the mean is 2.26%, in the wines of Austria 2.64% and in those of Hungary 2.62%. It is highest in sweet wines. In many adulterated wines, as the extractive matter is either very small or sometimes altogether absent, it has been proposed to employ the estimation of its amount in a wine as a test of its genuineness or the reverse.

Light wines owe their color, varying from pale yellow to brown, possibly to oxidized extractive matter or to the cask. The color of red wine is due to the action of its free tartaric acid on a blue substance residing in the skin of the grape. This body, which is known to wine makers as wine blue, and which bears a great resemblance to litmus, in turning red when acted upon by acids, was named *oenocyan* or *oenocyamin* by Mulder or Maumene. It is insoluble in water, alcohol, ether, olive oil and oil of turpentine, but is dissolved by alcohol containing small quantities of tartaric or acetic acid. Glycerine was found to be a normal constituent of wine by Pasteur in 1859. As the wine matures the glycerine disappears. In Austrian wines Pohl found 2.6% of glycerine. In some wines it reaches 3%, but in most it seldom exceeds 1%. In old wines it exists only in very small quantity.

Imitation Wines.

1.—From ripe saccharine fruits.—Take of the fruit, 4 to 6 lb.; clear soft water, 1 gal.; sugar, 3 to 5 lb.; cream of tartar (dissolved in boiling water), 1¼ oz.; brandy, 2 to 3%; flavoring as required. If the full proportions of fruit and sugar are used, the product will be good without the brandy, but better with it; 1¼ lb. raisins may be substituted for each pound of sugar.

In the above manner are made the following wines: Gooseberry wine, currant wine (red, white or black), mixed fruit wine (currants and gooseberries or black, red and white currants; ripe black heart cherries and raspberries, equal parts), a good family wine; cherry wine, colepress wine (from apples and mulberries, equal parts), elder wine, strawberry wine, raspberry wine, mulberry wine, whortleberry or bilberry wine; blackberry wine, damson wine, morella wine, apricot wine, apple wine, grape wine, etc.

2.—From dry saccharine fruit (such as raisins).—Take of the dried fruit, 4½ to 7½ lb.; clear soft water, 1 gal.; cream of tartar (dissolved), 1 oz.; brandy, 1½ to 4%. Should the dried fruit employed be at all deficient in saccharine matter, 2 to 3 lb. of it may be omitted, and half that quantity of sugar or two-thirds of raisins added. In the above manner are made date wine, fig wine, raisin wine, etc.

3.—From acidulous, astringent or scarcely ripe fruits or those which are deficient in saccharine matter.—Take of the picked fruit 2½ to 3½ lb.; sugar, 3½ to 5½ lb.; cream of tartar (dissolved), ½ oz.; water, 1 gal.; brandy, 2 to 6%.

In the above manner are made gooseberry wine, bullace wine, damson wine.

4.—From footstalks, leaves, cuttings, etc.—By infusing them in water, in the proportion of 3 to 6 lb. to the gal., or q. s. to give a proper flavor, or to form a good saccharine liquid, and adding 2½ to 4 lb. of sugar to each gallon of strained liquor; 1½ lb. of raisins may be substituted for each pound of sugar.

In the above manner are made grape wine (from the pressed cake of grapes), English grape wine, rhubarb wine (from garden rhubarb), celery wine, etc.

5.—From saccharine roots and stems of plants.—Take of the bruised, rasped or sliced vegetable 4 to 6 lb.; boiling water, 1 gal.; infuse until cold, press out the liquid and to each gal. add of sugar 3 to 4 lb.; cream of tartar, 1 oz.; brandy, 2 to 5%. For some roots and stems the water must not be very hot, as they are thus rendered troublesome to press.

In the above manner are made beetroot wine, parsnip wine, turnip wine, etc.

6.—From flowers, spices, aromatics, etc.—These are prepared by infusing a sufficient quantity of the bruised ingredient for a few days in any simple wine (as that from sugar, honey, raisins, etc.), after the active fermentation is complete, or, at all events, a few weeks before racking them.

In the above manner are made clary wine (muscatel) (from flowers, 1 qt. to the gallon); cowslip wine (from flowers, 1 qt. to the gallon); elder flower wine (flowers of white-berried elder, ¾ pt.; and lemon juice, 3 fl.oz. to the gallon); ginger wine (1¼ oz. ginger to the gallon); orange wine (1 doz. sliced oranges per gallon); lemon wine (juice of 12 and rinds of 6 lemons to the gallon); spruce wine (¼ oz. of essence of spruce per gallon); juniper wine (berries, ¾ pt. per gallon); peach wine (4 or 5 sliced and the stones broken, to the gallon); apricot wine (as peach wine, but with more fruit); quince wine (12 to the gallon); rose clove gillyflower, carnation, lavender, violet, primrose and other flower wines (distilled water from the flowers, 1½ pt., or flowers 1 pt. to the gallon); mixed fruit wine; pineapple wine; cider wine; elder wine; birch wine (from the sap, at the end of February or beginning of March); sycamore wine (from the sap); malt wine (from strong wort); and the wines of any of the saccharine juices of ripe fruit.

7.—From saccharine matter.—Take of sugar 3 to 4 lb.; cream of tartar, ½ oz.; water, 1 gal.; honey, 1 lb.; brandy, 2 to 4%. A handful of grape leaves or cuttings, bruised, or 1 pt. of good malt wort or mild ale may be substituted for the honey. Chiefly used as the basis for other wines, as it has little flavor of its own.

In all the preceding formulae lump sugar is intended when the wines are required very pale, and good Muscovado sugar when this is not the case. Some of the preceding wines are improved by substituting good cider, perry or pale ale or malt wort for a whole or a portion of the water. Good porter may also be advantageously used in this way for some of the deep-colored red wines. When expense is no object, and very strong wines are wanted, the expressed juices of the ripe fruits, with the addition of 3 or 4 lb. of sugar per gal., may be substituted for the fruit in substance and the water.

Management of Wine.

The remarks arranged under this heading are more particularly intended for the use of the maker, the dealer and the private individual, as those which precede it are for the wine maker.

Age.—The sparkling wines are in their prime in from 18 to 30 months after the vintage. Thin wines of inferior growths should be drank within 12 or 15 months and be preserved in a very cool cellar. Sound, well fermented, full-bodied still wines are improved by age, with reasonable limits, provided they be well preserved from the air and stored in a cool place having a pretty uniform temperature.

Acid Taste of Wines, To Remove.—Neutralize the excess of acid by powdered chalk.

Ages of Different Wines When at Their Prime.—The age named below for each wine will be found to be that at which it possesses its fullest flavor and when it will be best to drink it: Port, 20 years; Madeira, 10 years; Sherry, 10 years; Red Madeira, 6 years; Madeira-Malmsey, 5 years; Callavella, 4 years; Malaga, 3 years; Muscatel, 3 years; Red Hermitage, 20 years; White Hermitage, 20 years; Rousillon, 20 years; Rivesaltes, 20 years; Banyuls, 20 years; Collioure, 15 years; Salces, 10 years; La Palme, 10 years; Sigean, 8 years; Carcassone, 8 years; Beziers, 8 years; Lunel, 8 years; Champagne, 6 years; Montpellier, 5 years; Frontignan, 5 years.

Alcoholizing.—Alcohol is frequently added to weak or vapid wines to increase their strength or to promote their preservation. In Portugal one-third of alcohol is commonly added to port before shipping it to England, as without this addition it generally passes into the acetous fermentation during the voyage. A little alcohol is alsa usually added to sherry before it leaves Spain. The addition of alcohol to wine injures its proper flavor, and hence it is chiefly made to port, sherry and other wines whose flavor is so strong as not to be easily injured. Even when alcohol is added to wines of the latter description they require to be kept for some time to recover their natural flavor.

Bottling.—The secret of bottling wine with success consists in the exercise of care and cleanliness. The bottles should be sound, clean and dry, and free from the least mustiness or other odor. The corks should be of the best quality, and immediately before being placed in the bottles should be compressed by means of a cork squeezer or of one of the numerous machines made for this purpose. For superior or very delicate wines the corks are sometimes prepared by placing them in a copper or tub, covering them with weights to keep them down, and then pouring over them boiling water, holding a little pearlash in solution. In this liquid they are allowed to remain for 24 hours, when they are well stirred about in the liquid, drained and reimmersed for a second 24 hours in hot water, after which they are well washed and soaked in several successive portions of clean and warm rain water, drained, dried out of contact with dust, put into paper bags and hung up in a dry place for use. Many wine merchants, however, disapprove of this course and merely dip the corks in clean cold water before inserting them in the bottles. The wine should be clear and brilliant, and if it be not so, it must undergo the process of fining before being bottled. The bottles, corks and wine being ready, a fine clear day should be preferably chosen for the bottling, and the utmost cleanliness and care should be exercised during the process. Great caution should also be observed to avoid shaking the cask, so as not to disturb the bottoms. The remaniing portion that cannot be drawn off clear should be passed through the wine bag, and, when bottled, should be set apart as inferior to the rest, or the less are collected in a cask kept for the purpose, and the clear wine resulting from their subsidence is used for filling up casks about to be fined. The coopers, to prevent breakage and loss, place each bottle, before corking it, in a small bucket or boot having a bottom made of soft cork or leather, which is strapped on the knee of the bottler. The bottlers seldom break a bottle, though they flog in the corks very hard. The bucket or boot is now very largely supplanted by Gervaise's corking machine, an apparatus which first submits the cork to great pressure and then immediately afterward drives it firmly into the neck of the bottle, in which, owing to its subsequent expansion, it fits very closely and perfectly. When the process of bottling is complete the bottles of wine are stored in a cool cellar on their sides, but on no account in an upright position. Sometimes they are placed in damp straw or in sweet, dry sawdust or sand.

Cellaring.—A wine cellar should be dry at bottom and either covered with good hard gravel or be paved with flags. Its gratings or windows should open toward the north, and it should be sunk sufficiently below the surface to insure an equable temperature. It should also be sufficiently removed from any public thoroughfare so as not to suffer vibration from the passing of carriages. Should it not be in a position to maintain a regular temperature, arrangements should be made to apply artificial heat in winter and proper ventilation in summer. The temperature should range from 55 to 65° F. For Burgundies the former temperature is the more suitable; for ports sherries and strong wines the latter temperature.

Clarification of Wines.—If the wine is not clear and bright after racking it is necessary to clarify it. There are many causes which interfere with the proper brightness of wine, such as changes of temperature, in careless racking and others. Some wines clear themselves, so that clarification need not be resorted to. A great many diffrent substances have been employed in clarification. Many of that so-called clarifying powders are nothing but dried blood albumin. Isinglass or fish glue is one of the best agents for clarification. It is dissolved in water until little more fluid than molasses. Gelatine prepared from bone is also used and may be obtained in sheets or in small pieces and sometimes in tablets. It is one of the best agents that can be used in clarifying and is especially valuable for clarifying white wine. After wine has been clarified with the gelatine it should be racked after standing a short time. Blood albumin affords a cheap and efficient means of clarifying the wine in large quantities A gallon of blood beaten up with a gallon of the same kind of wine which it is desired to clarify will clarify 200 gallons of wine. Great care should be taken to have the blood fresh, as otherwise it is sure to injure, if not entirely destroy, the wine. It is especially successful in clarifying new wine. In case the wine loses a portion of its color it can be readily restored by an addition of the usual coloring matters.

Milk is used to some extent in place of the blood, but it is not as reliable. If the wine is of great value, the whites of eggs afford the best means of clarifying it, and should be used in all cases where expense is not an object. No pains should be spared to see that the eggs are entirely fresh, as otherwise the wines would be destroyed. The whites of the eggs are particularly efficient for white wine. The proper proportion is 1 egg per 10 gal. They should be beaten up with a small portion of wine with an egg-beater before adding to the wine. Gum arabic is also used, but is not as good as the white of egg or blood. Salt, alcohol and tannin and many other substitutes have been used with varying success. The ones already mentioned will give the best satisfaction.

Yellow White Wines.—The yellow color of white wines frequently stands in the way of their ready sale. It is removed by the blood albumin receipt given under clarification above. The receipt given under clarification of wines can also be used to bring white wine which has turned yellow back to its normal color.

Earthy Flavor of Wines.—This defect in wines is apt to interfere seriously with their sale, as the taste is particularly disagreeable. It may be the result of several causes. The vineyards may not be properly cared for or in low, wet land The treatment of wines which have earthy flavor requires much judgment and experience. Wines should be promptly clarified by the means already given and frequently racked. The white of egg receipt given under clarification is the best one to use for this defect. The addition of a small quantity of tannin dissolved in alcohol will also help to correct this defect.

Greeness.—This defect gives a very sour, unpleasant taste to the wine, owing to the malic and tartaric acids, which are in excess. There is no ordinary defect of wine which is more noticeable and more disagreeable than greenness. As its name implies, it is frequently caused by the use of unripe grapes. The treatment of the wine must be varied according to the taste. One of the various methods is to add from 1 to 3 qt. of old brandy to every 100 gal. of wine. Potassium tartrate affords a cheap and easy method of neutralizing the tartaric acid, forming potassium bitartrate, which may be afterward removed when the wine is right. The amount of potassium tartrate which may be used varies with the sourness of the wine, but 18 oz. per 100 gal. would be considered an average amount. Various other substitutes have been tried, but none is as successful as potassium tartrate.

Coloring Matters.—Various matters are largely employed to artificially heighten the colors of wines. The different spurious coloring matters can be detected by using a solution of lead acetate, and the precipitants formed give a good test by which the various colors can be determined.

1.—Malva flowers or hollyhock produce, when steeped in spirits for 24 hours, or even when boiled with water, a very beautiful purple.

2.—The pokeberry (the dark berries from the plant growing all over the United States) has a very dark red color.

3.—Whortleberry, huckleberry, elderberry, blackberry and mulberry.

4.—Cochineal gives a fine red color by boiling finely ground cochineal with cream of tartar.

5.—Brazil wood, saunders wood and log wood. These woods are boiled in water and the decoctions yield shades of color from red to blue.

6.—Orchil produces a beautiful purple.

7.—Red beets and carrots produce likewise a good color.

8.—Indigo solution, neutralized by potash, produces a fine blue.

9.—Annatto and extract of safflower produce a beautiful yellow.

10.—Red cabbage produces a beautiful bluish red.

11.—Turmeric is the most common color for yellow, as the spirit extracts all color immediately, as also quercitron bark.

12.—Garacine (extract of madder) produces various shades of red.

13.—Tincture of saffron (Spanish saffron) for yellow.

14.—Blue vitriol, or solution of indigo, produces blue.

15.—Burnt sugar produces a fine and permanent brown color for wines. It is best to boil down common sugar or loaf sugar nearly to dryness. It is then dissolved in hot water sufficient to make the consistency of syrup, and for the purpose of neutralizing it and making it a more permanent color, add to each gal. of sugar color about 1 oz. liquid ammonia.

16.—Green color for absinthe is prepared from a solution of extract of indigo and turmeric, dissolved in spirits.

17.—Violet is obtained by a solution of extract of logwood and alum.

18.—Alkanet root produces a fine blue red by macerating in alcohol.

19.—Barwood acquires a dark wine red color by digesting in alcohol.

20.—Brazil wood, by being macerated in alcohol or by boiling for ½ hour, produces a deep red.

Spurious Coloring Matter.—The following coloring matters give, with lead acetate, the following precipitates: Pure red wine gives bluish gray, red poppy gives dirty gray, elderberry gives dirty green, bilberry gives grayish green, privetberry gives green, dwarf elderberry gives bluish gray to violet in the fresh berries and fine green in the fermented extract, mallow flower gives dark green, logwood gives feeble dark blue, Brazil wood gives wine red.

The following colors, when present, give the following precipitates with alum and ammonium carbonate: Pure red wine gives dirty green, red poppy gives slate gray, elderberry gives bluish gray, bilberry gives bright violet, privetberry gives bright green, dwarf elderberry gives bright violet, mallow flower gives bluish violet, logwood gives dark violet, Brazil wood gives carmine red

Decanting.—In decanting wine care must be taken not to shake or disturb the crust when moving it about or drawing the cork, particularly of port wine. Never decant wine without a wine strainer, with some clean fine cambric in it, to prevent the crust and bits of cork going into the decanter. In decanting port wine do not drain it too close, as there are generally two-thirds of a wineglassful of thick dregs in each bottle which ought to be rejected. In white wine there is not much deposit but it should nevertheless be poured off very slowly, the bottle being raised gradually.

Detannation of Wines.—1.—The *Formulary* recommends the following method for removing the tannin or astringent matter from sherry wine: Sherry, 7 pt.; white of egg, 1 fl.oz.; alcohol, 1 pt. Beat the white of egg to a froth and mix it with wine; heat to about 170° F., or until the albumen is coagulated. Then cool, add the alcohol and after standing a few hours filter clear through paper. This wine is a much better menstruum and preservative medicine for organic substances than sherry itself.

2.—Gelatine, 1 oz.; distilled water, 10 oz.; sherry wine, 7 gal. Dissolve the gelatine in the water by heating, add the solution to the wine, stir well and allow it to remain 6 hours, then filter. Before using the wine in wine of coca, cinchona or beef, wine and iron, to bring it up to the strength of stronger wne as recommended in the Pharmacopeia, add 6 oz. alcohol to each gallon. Red or white wine may be detannated after the above formula.

Detartarization.—Rhenish wines, even of the best growths, and in the finest condition, besides their tartar, contain a certain quantity of free tartaric acid, on the presence of which many of their distinctive properties depend The excess of tartar is gradually deposited during the first years of the vatting, the sides of the vessels becoming more and more encrusted with it, but owing to the continual addition of new wine and other causes the liquid often gains such an excess of free tartaric acid as to acquire the faculty of redissolving the deposited tartar, which thus again disappears after a certain period. The taste and flavor of the wine are thus excited, but the excess of acid makes the wine less agreeable and probably less wholesome.

Under these circumstances the best correceive is pure neutral tartrate of potash. When this salt, in concentrated solution, is added to an acid wine the free acid combines with the neutral salt and separates from the liquid under the form of the sparingly soluble bitartrate of potash. If to 100 parts of a wine which contains 1 part of free tartaric acid we add 1½ parts of neutral tartrate of potash there will separate on repose at 70 to 75° F. 2 parts of crystallized tartar, and the wine will then contain only ½ part of tartar dissolved, in which there is only 0.2 part of the original free acid, 0.8 of the original free acid having been withdrawn from the wine. This method is particularly applicable to recent must and to wines which contain little, if any, free acetic acid. When this last is present so much acetate of potash is formed as occasionally to vitiate the taste of the liquid.

Fermentation.—Chemists divide fermentation into 5 kinds, viz.:

1.—Saccharine fermentation, by which starch and gum are converted into sugar.

2.—Alcoholic or vinous fermentation, by which sugar is converted into alcohol.

3.—Viscous or mucilaginous fermentation, which converts sugar into slime or mucilage instead of alcohol.

4.—Acetous fermentation, by which alcohol is converted into vinegar.

5.—Putrid fermentation, or putrefaction, which is exhibited in its most marked from in the putrefaction of animal substances.

Preventing fermentation.—1.—According to the *Technologiste*, common resin prevents the formation of acetic acid in fermented liquids without having any disturbing effect on the process of alcoholic fermentation. The peculiar effect of the hop may be due, it is suggested, to its resinous matter rather than to its oils. Resin is added to sweet wines in Greece.

2.—Silicate of soda has been discovered to exert a very decided chemical action in checking alcoholic fermentation, in this respect being somewhat similar to borax, although much more energetic. A small quantity of th esilicate will entirely arrest the fermentation of wine and also of milk.

Second fermentation, *La-pousse.*—Inordinate fermentation, either primary or secondary, in wine or any other fermented liquid, may be readily checked by sulphuration, or by the addition of sulphur, mustard seed, or sulphite of lime. The latter must, however, be used with discretio.

Stopping fermentation.—Bottle the liquor and immerse a number of the bottles, with the mouths only projecting, in a large vessel of water. Loosen the stoppers and heat the water until of a uniform temperature of 180° F., then remove the bottles, stopper and seal them tightly and place in an inverted position.

Filtration of Bottled Wines.—Filter siphon, with siphon-shaped bent glass tube which in the short leg, at about the height of the bottle, has an egg-shaped enlargement that is filled with clean cotton wadding. According to the greater or lesser length of the long leg, the suction of the apparatus will be more or less vigorous, while at the same time the wadding will retain the particles causing turbidity. For repeated use the wadding is cleansed by boiling out in water and drying.

Fining.—1.—There are various modes of fining wine. Eggs, isinglass, gelatine and gum arabic are all used for the purpose. Whichever of these articles is used, the process is always the same. Supposing eggs (the cheapest) to be used: Draw a gal. or so of the wine and mix 1 qt. of it with the whites of 4 eggs by stirring it with a whisk; afterward, when thoroughly mixed, pour it back into the cask through the bunghole and stir up the whole cask in a rotary direction with a clean split stick inserted through the bunghole. Having stirred it sufficiently, pour in the remainder of the wine drawn off until the cask is full. Then stir again, skimming off the bubbles that rise to the surface. When thoroughly mixed by stirring close the bunghole and leave it to stand for 3 or 4 days. This quantity of clarified wine will fine 13 doz. of port or sherry. The other clearing ingredients are applied in the same manner, the material being cut into small pieces and dissolved in the quart of wine and the cask stirred in the same manner.

White wines are usually fined by isinglass. The quantity of isinglass varies with the quality and condition of the wine, and is regulated by the experience of the cellarman. Stout wines require a larger amount than thin ones Even with stout ones it ought not to exceed ½ oz. to the hogshead. The Rhenish wines do not require more than ¼ oz. and the hocks still less. The choicest Russian isinglass only should be employed. It should be dissolved in cold water and thinned with wine. Red wines are generally fined with the whites of eggs in the proportion of 15 to 20 to the pipe. Sometimes, but rarely, hartshorn shavings or pale sweet glue is substituted for isinglass.

2.—Isinglass (ordinary), 1 lb.; stale beer, cider or vinegar, 3 or 4 pt. Mix and macerate until the former becomes gelatinous, then reduce it to a proper consistency with weak, mild beer, cider or any other liquid that the finings are intended for. A pint or more is the usual dose for a barrel of beer or porter and a quart for a hogshead of wine.

3.—Red Wines.—The operation is carried on in the same manner. To lighten up a wine add 6 eggs and a handful of salt, use the whites, yolks and shells.

4.—White Wine.—To fine 30 gal. white wine the whites of 3 eggs will be required with the addition of ½ an egg shell reduced to powder and a tablespoonful of salt. Beat up all together with a little of the wine and then pour gradually into the wine, stirring constantly.

Flatness.—This is removed by the addition of a little new brisk wine of the same kind or by rousing in 2 or 3 lb. of honey, or by adding 5 or 6 lb. of bruised sultana raisins and 3 or 4 qt. of good brandy per hogshead. By this treatment the wine will usually be recovered in about a fortnight, except in very cold weather. The process may be expedited if a tablespoonful or two of yeast be added and the cask removed to a warmer situation.

To Lay Down Wine.—Having carefully counted the bottles, they are stored away in their respective bins, a layer of sand or sawdust being placed under the first tier and another over it; a second tier is laid over this, protected by a lath, the head of the second being laid to the bottom of the first. Over this another bed of sawdust is laid, not too thick, then another lath, and so on till the bin is filled. Wine so laid in will be ready for use according to its quality and age. Port wine, old in the wood, will be ready to drink in 5 or 6 months, but if it is a fruity wine it will improve every year. Sherry, if of good quality, will be fit to drink as soon as the sickness (as its first condition after bottling is called) ceases, and will also improve, but the cellar must be kept at a perfectly steady temperature, neither too hot nor too cold, but about 55 or 60°, and absolutely free from draughts of cold air.

Insipidity. See *Flatness.*

Maturation.—The natural maturation, or ripening of wine and beer by age, depends upon the slow conversion of the sugar which escaped decomposition in the gyle tun or fermenting vessel into alcohol. This conversion proceeds most perfectly in vessels which entirely exclude the air, as in the case of wine in bottles, as when air is present and the temperature sufficiently high it is accompanied by slow acetification. This is the case with wine in casks, the porosity of the wood allowing the vey gradual permeation of the air. Hence the superiority of bottled over draught wine or that which has matured in wood. Good wine, or well fermented beer, is vastly improved by age when properly preserved, but inferior liquor or even superior liquor, when preserved in improper vessels or situations, becomes acidulous from the conversion of its alcohol into vinegar. Tartness or acidity is consequently very generally, though wrongly, regarded by the ignorant as a sign of age in liquor. The peculiar change by which fermented liquors become mature or ripe by age is termed the insensible fermentation. It is the alcoholic fermentation impeded by the presence of the already formed spirit in the liquor and by the lowness of the temperature.

Mould or fungus is very frequently produced by keeping the wine in too warm a cellar, or in a cask not filled to the bunghole, or else in one from which the bung has been left out. As it forms mostly on weak wines its presence may be referred to a deficiency of alcohol.

The best method for its removal is either burning sulphur in a partially filled cask or drawing off the wine into a fresh cask in which sulphur has been previously burnt. It is advisable that wines so treated should be drunk as soon as possible.

Wine sometimes has an unpleasant musty taste, which it has acquired from being put into a dirty cask or into one that has been unused for some time. This bad flavor, which is known as caskiness, may generally be removed by vigorously agitating the wine for some time with a little sweet olive or almond oil. The cause of the bad taste is the presence of an essential oil, which the fixed oil combines with and carries to the surface, whence it may be skimmed off, or the wine lying under it may be drawn off. A little coarsely powdered and freshly burnt charcoal, or some slices of bread toasted until they become black, or a little bruised mustard seed sometimes effects the removal of the objectionable taste.

Mellowing Wines.—Cover the orifices of the vessel containing it with bladder closely fastened, instead of the usual materials, and an aqueous exhalation will pass through the bladder, leaving some fine crystallizations on the surface of the wine, which, when skimmed off leaves the wine in a highly improved state of flavor. Remnants of wine covered in this manner, whether in bottles or in casks, will not turn mouldy as when stopped in the usual way, but will be improved instead of being deteriorated.

Ripening.—To promote the maturation

or ripening of wine various plans are adopted by the growers and dealers. One of the safest ways of hastening this, especially for strong wines, is not to rack them until they have stood 15 or 18 months upon the lees, or, whether crude or racked, keeping them at a temperature ranging between 55 and 65° F. in a cellar free from draughts and not too dry. Full or heavy sherries or ports, when bottled and treated in this manner, ripen very quickly in a temperate situation.

Racking.—Racking should be performed in cool weather and preferably early in the spring. A clean siphon, well managed, answers better for this purpose than a cock or faucet. The bottoms, or thick portion, may be strained through a wine bag and added to some other inferior wine.

Ropiness, Viscidity.—This arises from the wine containing too little tannin or astringent matter to precipitate the gluten, albumen or other azotized substance, occasioning the malady. Such wine cannot be clarified in the ordinary way because it is incapable of causing the coagulation or precipitation of the finings. The remedy is to supply the principle in which it is deficient. M. Francois, of Nantes, prescribes for this purpose the bruised berries of the mountain ash in the proportion of 1 lb. to the barrel. A little catechu, kino, or, better still, rhatany, or the bruised footstalks of the grape, may also be conveniently and advantageously used in the same way. For pale white wines, which are the ones chiefly attacked by the malady, nothing equals a little pure tannin or tannic acid dissolved in proof spirit.

Sparkling Creaming and Briskness.—These properties are conveyed to wine by racking it into closed vessels before the fermentation is complete and while there still remains a considerable portion of undecomposed sugar. Wine which has lost its briskness may be restored by adding to each bottle a few grains of white lump sugar or sugar candy. The bottles are after ward inverted, by which means any sediment that forms falls into the necks, when the corks are partially withdrawn and the sediment is immediately expelled by the elastic force of the compressed carbonic acid. If the wine remains muddy a little solution of sugar and finings are added and the bottles are again placed in a vertical position, and, after two or three months, the sediment is discharged as before.

To Sweeten Wine.—In 30 gal. of wine infuse a handful of the flowers of clary; then add 1 lb. of mustard seed, dry ground, put it into a bag and sink it to the bottom of the cask.

Tartaric Acid in Wine, Detection of Free.—Professor Claus evaporates to a syrup and agitates with ether. If free tartaric acid is present the ether leaves on evaporation a crystalline deposit, which, if dissolved in water, gives, on the addition of an alcoholic solution of potassic acetate, a precipitate of tartar. The author proves the solubility of tartaric acid in ether, which is denied in most text books.

Sour Wine, To Restore.—1.—Take calcined gypsum, in powder, 1 oz.; cream of tartar, in powder, 2 oz. Mix them in a pint or more of brandy; pour it into the cask; put in also a few sticks of cinnamon and then stir the wine without disturbing the lees. Bung up the cask next day.

2.—Boil 1 gal. of wine with some beaten oyster shells and crab's claws, burnt into powder, an ounce of each to every 10 gal. of wine; then strain out the liquor through a sieve, and when cold, put it into wine of the same sort and it will give it a pleasant, lively taste. A lump of unslaked lime put into each cask will also keep the wine from turning sour.

Sourness in Wine, to Correct a Bad Taste and Sourness.—Put in a bag the root of wild horseradish cut in bits. Let it down in the wine and leave it there 2 days; take this out and put in another, repeating the same till the wine is perfectly restored. Or fill a bag with wheat; it will have the same effect.

Formulas.

Apple Wine.—1.—Finest cider, 60 gal.; brown sugar, ½ cwt.; bitter almonds, ¼ oz. Mix the cider and sugar and ferment; then rack the mixture and put into the cask the almonds, with 16 or 18 cloves and 3 or 4 pieces of bruised ginger. When fine bottle it and keep it in a cool place. The addition of a small piece of lump sugar to each bottle will make the cork fly out, as from champagne; but do not add this unless you have a very cold cellar to keep it in.

2.—Sugar, 40 lb.; cider, 15 gal. The cider must be pure and made only from really ripe, sound apples (this is important) If the wine is to be quite sweet, add another 10 lb. of sugar and put all into the cider, letting it stand till dissolved. Put the liquor into a cask, but leave it unfilled to the extent of 2 gal. Put the cask into a cool position, with the bung out for 48 hours. After this bung it up, but let there be a small vent somewhere—in the bung would do—until the fermentation is over. Then bung up securely and the wine will be ready for consumption in 12 months. There is no racking required in the manufacture of this wine. To remain in the cask 12 months. Make this in January or February.

3.—Put 5 gal. of good cider into a cask it will about ¾ fill, add 10 lb. of loaf sugar and stir occasionally with a piece of wood or cane until the sugar is quite dissolved. At the end of 48 hours put in the bung and place a small vent peg near the top of the cask. Allow the cask to remain for 12 months in a cool, dry place, when the wine will be ready for use.

Apricot Wine.—1.—Ripe apricots, 12 lb.; loaf sugar, 6 oz. to each qt. liquor. Wipe the apricots, cut them in pieces and let them boil in 2 gal. water. After boiling let them simmer till the liquor is strongly impregnated with the flavor of the fruit. Strain through a hair sieve and put 6 oz. lump sugar to every quart liquor. Boil again, skim very carefully and as soon as no more scum appears put it into an earthen pan. Bottle next day if it is quite clear and put 1 lump of sugar into each bottle. It should be fine wine in 6 months. Two hours to boil. Make this in August or September.

2.—Sound but not overripe apricots, 12 lb.; loaf sugar, 1 lb.; white wine, 1 pt.; water, 3 gal.; compressed yeast, 1 tablespoonful, or good brewer's yeast, 1 tablesponful. Remove the stones of the fruit, take out the kernels and cut each apricot into 6 or 8 pieces. Put them into a preserving pan with the water, sugar and about half the kernels and simmer very gently for 1 hour. Turn the whole into an earthenware vessel, let it remain undisturbed until cool, then stir in the yeast. If compressed yeast is used it must previously be mixed smoothly with a little warm water. Cover the vessel with a cloth, let it remain undisturbed for 3 days, then strain the liquid into a clean, dry cask, add the white wine and bung lightly. At the end of 6 months draw off the wine into bottles, cork them closely, store in a cool, dry place for about 12 months and the wine will be then ready for use.

3.—Firm, ripe apricots, 12 lb.; loaf sugar; water, 2 gal. Prepare the fruit as directed in the preceding recipe, put it into a preserving pan with 2 gal. of cold water and half the kernels and boil gently for about 1 hour. Strain, return to the pan; to each quart of liquid add 6 oz. of loaf sugar, bring to the boil and remove the scum as it rises. Let the whole simmer gently for 10 minutse, then turn into an earthenware vessel. Allow it to remain covered until the following day, pour into dry bottles, to each one add a lump of sugar and cork closely. Store in a cool, dry place for about 6 months, when the wine should be ready for use.

Blackberry Wine.—1.—To 1 gal. of mashed blackberries add a quart of boiling water; let it stand for 24 hours, or nearly as long, then strain through a coarse bag or towel, adding 3 qt. of water and 2 lb. of brown sugar to each gallon of the mixture, making equal parts of water and juice; mix well, then put in demijohns, stone jugs or a tight, clean keg; close partially and put in a cool place; if in a warm place or left entirely open it will sour; if stopped entirely tight it will burst the vessel—but cork left loosely in; let it stand until fermentation ceases, which will be about October; then bottle, and this makes excellent wine and a fine medicinal drink for summer affections.

2.—The following is said to be an excellent receipt for the manufacture of superior wine from blackberries: Measure your blackberries and bruise them; to every gallon add 1 qt. of boiling water; let the mixture stand 24 hours, stirring occasionally; then strain off the liquor into a cask; to every gallon add 2 lb. of sugar; cork tight and let stand about 1 year, and you will have wine fit for use without any further straining or boiling. This wine is very highly recommended for household use.

Catawba Champagne.—Catawba, 20 gal.; cognac brandy, 1 qt.; champagne syrup, 2 gal.

Chmapagne, Imitation.—1.—Prepared cider, 25 gal.; citric acid, 5 dr.; simple syrup, 1¼ pt.; water, 1¼ gal.; spirits (10 under proof), 2½ gal.; tartaric acid, 1¼ oz. Let this stand 12 days, then fine and bottle, if it is frothing and sparkling; if not, add more acid and fine again. Add to each bottle about 2 teaspoonfuls of syrup, made by dissolving ½ lb. rock candy in 1 pt. white wine

2.—Cider, pale, 1 hhd.; spirit, 3 gal.; honey or sugar, 20 lb. Mix and allow to remain 2 weeks; then fine with skimmed milk, ½ gal. This will be very pale.

3.—Cheap Champagne.—Bordeaux, 10 gal.; Bodenheimer or Hockheimer, 10 gal.; water, 10 gal.; French spirit, 1 gal.; syrup, 3 gal. Made of 18 lb. sugar and 6 qt. water.

4.—Goosebberry.—Ferment together 5 gal. white gooseberries, mashed, with 4½ gal. water. Add 6 lb. sugar, 4½ lb.

honey, 1 oz. finely powdered white tartar, 1 oz. dry orange and lemon peel and ½ gal. white brandy. This will produce 9 gal. Before the brandy is added the mixture must be strained and put into a cask.

5.—Liqueur.—Fine loaf sugar, 13 lb.; water, 1½ gal. Boil together. While boiling add by degrees 3 qt. alcohol, 90%, filter. Add to the following compound:

Cherry Wine.—Take of cold water 10 gal.; cherries, 10 gal.; ferment. Mix raw sugar, 30 lb.; red tartar, in fine powder, 3 oz.; add brandy, 2 or 3 qt. This will make 18 gal. Two days after the cherries have been in the vat we should take out about 3 qt. of the cherry stones, break them and the kernels and return them into the vat again.

Cherry Wine, Black.—Small black cherries, 24 lb.; sugar, 2 lb. to each gallon of liquor. Bruise the cherries, but leave the stones whole, stir well, and let the mixture stand 24 hours. Then strain through a sieve, add the sugar, mix again and stand another 24 hours. Pour away the clear liquor into a cask and when fermentation has ceased bung it closely. Bottle in 6 months' time. It will keep from 12 to 18 months. Time—To remain in the cask 6 months. Make this in July or August.

Claret.—1.—Prepared cider, 30 gal.; good port wine, 6 gal.; water, 1½ gal.; tartar, 1½ lb.; syrup, 1½ pt.; citric acid, 2¼ dr.; raisins, 3 lb. Color if desired with red saunders or red beet juice. Let it stand 10 to 12 days, rack.

2.—Good cider and port wine, equal parts.

3.—To each gallon of the last add cream of tartar (genuine), 3 dr., and the juice of 1 lemon.

4.—To either of the preceding add French brandy, 2 oz.

5.—Instead of port, use red cape or British port.

If the first three of the above are well mixed and fined down and not bottled for a month or 5 weeks, they can scarcely be distinguished from good Bordeaux. A mixture of 4 parts of raisin wine with 1 part each of raspberry and barberry or damson wine also forms an excellent factitious claret.

6.—Place 12 lb. of cherries, preferably small black ones, on a large dish and bruise them well with a large wooden spoon. Allow them to remain until the following day, then drain them well on a hair sieve and measure the juice into an earthenware vessel. To each quart of juice add ½ lb. of sugar, cover the vessel, let it stand for 24 hours and strain the liquor into a clean, dry cask. Bung closely, but provide the upper part of the cask with a vent plug; let it remain undisturbed for about 6 months, then drain off into bottles. Cork closely, store in a cool, dry place and use as required.

7.—Choose cherries as ripe as possible without being overripe. They are mashed up or comminuted in some manner and the mass freed from pits is carefully measured. On account of a jelly-like substance in the juice, which makes it hard to handle, a little water is now added to the crushed mass and it is set aside for 24 hours. At the end of this time press off the mass, and to every quart of it add enough water, including that added at first, to make 2 qt. for every quart of cherries, first, however, dissolving in the said water, by the aid of heat, 2 lb. of refined sugar and ½ dr. (30 gr.) of tartaric acid. Put the mixture in a clean keg or barrel, add a little brewer's yeast and let it ferment at a temperature of 70 to 75° F. for from 4 to 6 weeks. Draw the wine off, at the end of fermentation, into a clean container and let stand for 6 to 8 weeks (best in a temperature as near that at which it fermented) to ripen. It is now ready for bottling off. The bottles should be well stoppered and kept in a cool cellar.

Coca Wine.—This is a French preparation. Its strength is about 1 in 30 and the dose a wineglassful. Coca wine is, roughly speaking, about one-sixth of the strength of the official liquid extract (*Extractum Cocae Liquidum* B. P., or *Extratum Erythroxyli Fluidum* U. S.). To obtain the liquid extract, coca leaves are exhausted by percolation (which differs from either decoction or infusion) with proof spirit.At the termination of the process the strength should be adjusted so that 1 oz.=1 of leaves. The process of percolation is as follows: The leaves are placed in a vessel very like an elongated funnel, closed at its base by a porous diaphragm. This funnel fits into a receiver, and a small tube passes up its outer side and enters it near the top, forming a means of communication between the two. Spirit is now poured on the leaves and the percolator closed. As the percolate filters slowly through into the reservoir the displaced air passes up the tube and so maintains an equilibrium in both vessels. The virtue of the coca leaves lies principally in the presence of the alkaloid cocaine. This, in the dried leaves, is supposed to exist as an inert salt, similar to many of the cinchona alkaloids in bark.

Cowslip Wine.—To every gallon of water allow 3 lb. of lump sugar, the rind of 2 lemons, the juice of 1, the rind and juice of 1 Seville orange, 1 gal. of cowslip pips. To every 4½ gal. of wine allow 1 bottle of brandy. Boil the sugar and water together for ½ hour, carefully removing all the scum as it rises. Pour this boiling liquor on the orange and lemon rinds, and the juice, which should be strained; when milk-warm add the cowslip pips or flowers, picked from the stalks and seeds; and to 9 gal. of wine 3 tablespoonfuls of good fresh brewer's yeast. Let it ferment 3 or 4 days, then put all together in a cask with the brandy and let it remain for 2 months, when bottle it off for use. To be boiled ½ hour; to ferment 3 or 4 days; to remain in the cask 2 months. Make this in April or May.

Currant Wine.—Squeeze the currants through a coarse bag; have equal parts of water and juice or 1-3 water, as taste may direct, and add 3 lb. of loaf sugar to each gallon of the mixture; mix well and bottle in stone jugs or demijohns; treat same way as blackberry wine—partially corked and keep in a cool place. Some keep a bottle of the mixture to fill up the vessels as they effervesce, but it is not always necessary. Bottle in October, when fermentation ceases; this makes a beautiful and delicious wine and improves with age.

Red.—Ripe red currants. To each gallon of fruit allow 1½ gal. of cold water and 5 lb. either loaf sugar or good preserving sugar and ½ pt. of good brandy. Remove the stalks from the currants, put them into an earthenware bowl, bruise them well with a wooden spoon and drain off the juice. Put the juice aside, add the water to the berries, let it stand for 2 or 3 hours, stirring occasionally meanwhile. At the end of this time strain the liquid from the berries into the juice, add ¾ of the sugar, stir occasionally until dissolved, then pour the whole into a cask, filling it 3 parts full. Bung closely, but place a vent peg near the top of the cask and let the cask remain for 1 month where a uniform temperature of about 65° F. can be maintained. Dissolve the remainder of the sugar in the smallest possible quantity of warm water, mix it well with the contents of the cask, replace the bung and allow the cask to remain undisturbed for 6 weeks longer. Now drain off the wine into a clean, dry cask, add the brandy, let the cask stand for about 6 months in a dry, warm place, then bottle and cork tightly. The wine may be used at once, but will be better if kept for 12 months at least.

Red Currant and Raspberry Wine.—Red currant juice, 5 gal.; raspberry juice, 1 pt.; water, 10 gal.; either loaf sugar or good preserving sugar, 10 lb. Extract the juice as directed in the two preceding recipes. Add to it the water and sugar, stir until the latter is dissolved, then turn the whole into a cask and bung closely, but provide the top of the cask with a vent peg. As soon as fermentation ceases tighten the vent peg and let the cask remain undisturbed in a moderately warm place for 12 months. At the end of this time rack off into dry bottles, cork them closely and seal the top with melted wax. The wine should be ready for use in about 3 months.

Currie Wine.—Currie powder, 5 oz.; white wine, 1 gal. Digest for 1 week and strain.

Damson Wine.—1.—Water, 12 gal.; damsons (bruised), 8 gal.; raw sugar, 30 lb. Ferment, then add red tartar (dissolved), 6 oz.; cloves (bruised), ¼ oz. Let it stand until fine, then bottle.

2.—Crush 20 lb. irpe damson plums: boil in 3 gal. water; press out the juice; add 6 lb. sugar; put in a barrel and let it ferment; then add after 2 weeks a little good brandy; bottle.

3.—One gal. of boiling water to every 8 lb. of bruised fruit, 2½ lb. of sugar to each gallon of juice. Well bruise the fruit and pour the boiling water on it; let it stand for 48 hours. Then strain the mixture into a cask and put in the sugar. When fermentation ceases fill up the cask and bung closely. Bottle in 10 months' time. It will be fit for use in a year, but improves with keeping. Time required. about 2 years.

4.—To each gallon of damsons add 1 gal. of boiling water. To each gallon of liquor obtained from these add 4 lb. of loaf sugar and ½ pt. of French brandy. Remove the stalks, put the fruit into an earthenware bowl, pour in the boiling water and cover with a cloth. Stir the liquid 3 or 4 times daily for 4 days, then add the sugar and brandy, and when the former is dissolved turn the whole into a clean dry cask. Cover the bunghole with a cloth, folded into several thicknesses, until fermentation ceases, then bung tightly and allow the cask to remain undisturbed for 12 months in a moderately warm place. At the end of this time it should be acked off into bottles. The wine may be used at once, but if well corked and stored in a dry place it may be kept for years.

Elder Wine.—1.—Elderberries, 7 lb.; water, 3 gal.; to each gallon of liquid thus obtained add: good loaf sugar, 3 lb.; raisins, 1 lb.; ground ginger, ½ oz.; cloves, 6; brandy, ¼ pt.; brewer's yeast, ½ teaspoonful. Strip the berries from the stalks, pour the water, quite boiling, over them, let them stand for 24 hours, then bruise well and drain through a hair sieve or jelly bag. Measure the juice obtained, put it into a preserving pan with sugar, raisins, ginger and cloves, in above stated proportions, boil gently for 1 hour, and skim when necessary. Let the liquid stand until milk-warm. Then stir in the yeast, and turn.

2.—Alcohol, 90%, 12½ gal.; water, 12½ gal.; elderberries, juice of, 6¼ gal.; loaf sugar, 18¾ lb.; port wine, 2¼ gal.; orange-flower water, ⅝ pt. Allow it to stand 1 week; draw off.

Elderberry Wine.—1.—Gather the berries when quite ripe, on a dry day; pick them off the stems and bruise them with your hands. Strain the juice; let the liquor rest in glazed earthenware pans for 12 hours to settle. Allow to every pint of juice 1½ pt. of water, and to every gallon of the mixed water and juice 3 lb. of good moist sugar. Put it over the fire in a large saucepan, and when it is ready to boil, clarify it with the whites of 4 eggs. Let it boil for an hour, and when nearly cold put in some yeast to work it; pour it into the cask, reserving some of the liquor to fill up the cask with, as it sinks with working. If you have about 10 gal. or so, it should be fit to bottle off in 2 months' time after it has been closed down. Keep at least a year in bottle.

2.—Gather the berries when quite ripe, and in dry weather. Pick them clean; put them into a copper with ½ gal. of water, and keep up a slow fire until the berries sink; then strain the juice through a hair sieve, and to every gallow of it allow 3 gal. of soft water, and to every gallon of the mixed liquor 3 lb. of good moist sugar. Put back into the copper and boil for an hour, skimming thoroughly; draw off into a tube, and when it is about 70° put a toast, spread with yeast, into it, and let it work for 48 hours, or longer, if necessary; pour it, or draw it off, if you have a tap in your tub, as should be the case, into the cask which is to hold it; and if you have 18 gal. of liquor, add 1 oz. of cloves, 2 oz. of allspice, 2 oz. of Jamaica ginger, and 1 oz. of sweet almonds, all bruised. Bung very slightly until fermentation is quite over; then close down tightly and tap in 3 months.

3.—Old recipe: Put the ripe, picked-over berries into an earthen pot; put this into a copper with sufficient water to come up about two-thirds of the height of the pot, which is about as far as the berries should reach inside; be careful that no water touches them. Make a gentle fire, and keep the pot in the water till it is quite hot, then take it out. Pour the berries into a coarse cloth, strain the juice, and put it into a large saucepan; to every quart of juice allow 1 lb. of good moist sugar; let it boil, and skim well. It should boil until rather thick, then pour it into a jar. Put 60 lb. of raisins into a cask, and fill it up with water; let it stand for a fortnight; stir it well every day; then pour off the liquor into a clean cask that just holds it. It should stand until it has done hissing; then bung it down close, and stand until fine. To every gallon of this liquor allow ½ pt. of the elder syrup: mix well, and when it has fined down, rack off into another cask; bottle off after 3 months.

4.—Chop a quantity of Malaga raisins quite fine; allow 1 qt. of water to every lb. of raisins, and put raisins and water into an open tub; cover over with a double cloth and let it stand for 9 days, stirring up each day. Then draw off the liquor as long as it will run, and press the raisins to get out the remainder of the juice; mix all together in a barrel To every gal. of liquor allow 1 pt. of the juice of elderberries, prepared simply by mashing the berries with the hands and straining off the juice. Stop down close, and stand for 6 weeks; then draw off the fine liquor, and to every gal. add ½ lb. of moist sugar. Stand again until quite fine, and then bottle off. Keep in a cool cellar for use.

Elder Flower Wine is made from the flowers, in this manner: 1.—Gather the flowers on a dry day; remove all stalks, and to every qt. of flowers allow 1 gal. of water and 3 lb. of loaf sugar; boil the sugar and water for ¼ hour; then pour it on the flowers, and let it work for 3 days; then strain the wine carefully thruogh a hair sieve, and put it into a cask. To every 5 gal. of wine add ½ oz. of isinglass, dissolved in cider, and 3 eggs (whites only), beaten up; close up the cask, and stand six months before bottling off.

2.—Boil 18 lb. of powdered loaf sugar in 6 gal. of spring water; beat up the whites of 2 eggs, and add; skim very thoroughly, and put in ¼ peck of elder flowers, picked from their stems; take off the fire, and stir until cool; then add

4 tablespoonfuls of yeast and 6 spoonfuls of lemon juice, strained, and free from pips; mix well with the liquor by stirring twice daily for 4 days. Stone 6 lb. of Malaga raisins, and put them into a well cleaned out cask; pour the wine upon them. Stop up the cask closely, and keep it in a rather warm place. If made in July or August, bottle off in February or March. This wine, when well made, very much resembles Frontignac.

Fig Wine.—Figs are largely employed, especially in Algeria, for the production of fictitious wine. For this purpose, figs from Asia Minor are preferred, on account of their relative cheapness, and richness in sugar. When the fruit is treated with a suitable quantity of tepid water, acidified with tartaric acid, fermentation rapidly commences, resulting in the production of a vinous liquid of about 8° alcoholic strength, and so inexpensive that it defies all competition of genuine grape wine, Algerian or otherwise. Fig wine cannot be distinguished either by taste or the ordinary methods of analysis, from genuine grape wine, especially when it is mixed with a proportion of the latter. The detection of fig wine, however, is rendered comparatively easy by the fact that it contains mannitol. In order to separate the mannitol, 100 c. c. of fig wine are evaporated to a syrup, which is allowed to stand in a cool place for 24 hours. At the end of this time the residue will have solidified, well defined groups of crystals being formed. The crystals are washed with cold alcohol of 85% strength, in order to remove impurities. The residue is mixed with animal charcoal, and extracted with boiling 85% alcohol, and filtered. The alcoholic solution yields on evaporation a crystalline mass of mannitol, which may be recognized by its physical and chemical properties. Certain white wines from the Gironde district, as well as raisin and some other wines, contain mannitol, but only to the extent of a few decigrams per liter; while fig wine contains from 6 to 8 grams per liter. By a determination of the mannitol it is possible to detect an adulteration of normal Algerian wine with ½ or even ¼ of fig wine.

Ginger Wine.—1.—Cold water, 3 gal.; loaf sugar, 9 lb.; whole ginger, bruised, ¼ lb.; raisins, ¼ lb.; lemons, strained juice and finely prepared rinds of 4; brewer's yeast, 1 good tablespoonful. Stone and halve the raisins, put them into a large preserving pan, or perfectly clean copper, with the water, sugar and ginger, bruised; boil for 1 hour, skimming frequently. Turn the whole into a large earthenware bowl or wooden tub, allow the liquid to stand until milk-warm, then stir in the yeast. On the following day put the preparation into a clean, dry cask, add the lemon juice, and bung lightly. Stir the wine every day for a fortnight, then tighten the bung. Let the wine remain undisturbed for 3 or 4 months, when it may be bottled for use.

2.—Water, 6 gal.; loaf sugar, 14 lb.; whole ginger, bruised, 6 oz.; Muscatel raisins, 2 lb.; Valencia raisins, 4 lb.; isinglass, ½ oz.; lemons, 6; brandy, 1 pt. Remove the peel of the lemons as thinly as possible, and boil it with the water, sugar and ginger for half an hour. Meanwhile, stone and halve the raisins, put them into an earthenware bowl, pour the liquid over them when nearly cold, add the lemon juice and yeast. Stir it every day for a fortnight, then add the isinglass, peviously dissolved in a little warm water, and drain into a clean, dry cask. Let the wine remain closely bunged for about 3 months, then bottle for use.

3.—This is an excellent stomachic, and is very popular in England as a cheap substitute for a grape wine: Sugar, 12 lb.; water, 3½ gal.; ginger, 4 oz. Boil them together for half an hour; when cooled to 75° add the rinds of 6 lemons and some good yeast; let it ferment for 10 or 14 days, then add 1 pt. of brandy and bottle it for use.

4.—To 9 gal. of water allow 27 lb. of loaf sugar, 9 lemons, 12 oz. of bruised ginger, 3 tablespoonfuls of yeast, 2 lb. of raisins, stoned and chopped, and 1 pt. of brandy. Boil together for 1 hour in a copper (let it previously be well scoured and beautifully clean) the water, sugar, lemon rinds and bruised ginger. Remove every particle of scum as it rises, and when the liquor is sufficiently boiled put it into a large tub or pan, as it must not remain in the copper. When nearly cold, add the yeast, which must be thick and very fresh, and the next day put all in a dry cask with the strained lemon juice and chopped raisins. Stir the wine every day for a fortnight; hen add the brandy, stop the cask down by degrees, and in a few weeks it will be fit to bottle. Sufficient to make 9 gal. of wine. The best time for making this wine is either in March or September.

Gooseberry.—1.—Firm green gooseberries, 20 lbs.; hot water, 3 gal.; loaf sugar, 15 lb.; cream of tartar, 1½ oz. Top and tail the gooseberries, put them into an earthenware bowl or wooden tub, and pour over them the hot water. Let them soak for 24 hours, then bruise them well with a heavy wooden mallet or potato masher, and drain the juice through a fine hair sieve or jelly bag. Replace the skins in the vessel in which they were soaked, cover them with boiling water, stir and bruise well, so as to completely extract the juice, then strain through the sieve or bag. Mix this preparation with the juice, add the sugar, and boiling water to increase the liquid to 5 gal. Replace in the bowl or tub, stir in the cream of tartar, cover with a heavy woolen cloth, and allow the vessel to stand in a moderately warm place for 2 days. Now strain the liquid into a small cask, cover the bunghole with a folded cloth until fermentation ceases—which may be known by the cessation of the hissing noise—then bung closely, but provide the top of the cask with a vent peg. Make this wine in the beginning of June, before the berries ripen; let it remain undisturbed until December, then drain it off carefully into a clean cask. In March or April, or when the goosebery bushes begin to blossom, the win emust be bottled, and tightly corked. To insure its being clear and effervescing, the wine must be bottled at the right time, and on a clear day.

Grape Wine.—1.—Ripe Grapes.—Mash sound, ripe grapes well with your hands, in an earthen pan, or if not with your hands, with a perfectly tasteless stick of wood. Do not crush the seeds; strain the liquor into a cask, gently squeeze the pulp, pouring the remainder of the juice into the cask (strained). Let it stand aside for a fortnight, then draw it off into another cask, covering up the bunghole with a piece of slate till all fermentation has ceased. Bottle in 6 months, cork, and seal, and it will be drinkable in 12 months' time.

2.—Grape Wine.—Ten lb. fresh grapes are put into a large jar or crock, 3 qt. boiling water poured over them, and when the water is cool enough to permit of it, squeeze the grapes well with the hand. After allowing the jar to remain 3 or 4 days covered with a cloth, press out the grapes, then add 5 lb. of sugar. Allow it to remain for 1 week, skim and strain carefully, then bottle, corking loosely. After the fermentation is completed strain and seal tightly.

3.—Put 20 lb. of ripe grapes into a stone jar, and pour on 6 qt. of boiling water; when cooled sufficiently squeeze by hand. Cover jar with cloth, let stand for 3 days, then press out the juice; add 10 lb. crushed sugar. After standing a week, scum, strain and bottle, corking loosely. When fermentation is complete strain again and bottle, corking tightly. Lay n side in cool place.

4.—Sound, not overripe grapes; to each lb. allow 1 qt. of cold water; add to each gal. of liquid obtained from the grapes 3 lb. of loaf sugar, ¼ pt. of French brandy, and ½ oz. of isinglass. Strip the grapes from the stalks, put them into a wooden tub or earthenware bowl, and bruise them well. Pour over them the water, let them stand for 3 days, stirring frequently, then strain through a jelly bag or fine hair sieve. Dissolve the sugar in the liquid, then pour the whole into a cask. Bung lightly for a few days until fermentation subsides, then add the isinglass, dissolved in a little warm water, and the brandy, and tighten the bung. Let the cask remain undisturbed for 6 months, then rack the wine off into bottles, cork and seal them securely, and keep for at least a year before using.

5.—*Hock, British Red.*—From cream of tartar, 1¼ oz.; tartaric acid, ½ oz. (both in very fine powder); juices of the purple plum, ripe apples, and red beet, of each (warmed), 5 pt.; lemon juice, 1 pt.; with white sugar, 2½ lb. per gal.

Honey Wine.—1.—Honey, 20 lb.; cider, 12 gal.; ferment, then add: Rum, ½ gal.; brandy, ½ gal.; red or white tartar, dissolved, 6 oz.; bitter almonds, ¼ oz.; cloves, ¼ oz. This is also called mead wine.

2.—According to Dzierzon.—In a polished copper kettle mix 12½ parts of honey with 55 parts of water, allow it to boil gently, and skim off the scum. After half an hour introduce gradually 1½ parts of finely crushed chalk, constantly stirring. The tough substance this froms on the surface is skimmed off, and when no more appears pour the fluid into a wooden vessel, so that as it rests and cools the chalk will settle. The fluid is then carefully poured off, so that all the chalk is left behind, returned to the kettle, which has again been cleaned, where it receives an admixture of 3 parts of pulverized charcoal, well purified by heating to redness. It is then poured for the second time into the cleansed wooden vessel, cooled, then filtered through a conical bag of felt or flannel. It is then returned to the kettle and heated to boiling. In the meantime the whites of 25 eggs are beaten, with water, to a foam, and gradually added to the fluid. By this means it is completely fined, the egg-white taking up any particles of charcoal or other impurities, to be removed as scum. The chalk takes away the acid, the charcoal the waxy flavor. The fluid having boiled for an hour after the addition of the egg-white, it is cooled, racked into a cask, which should not be quite full, a small space being left at the bunghole, which is covered with a piece of clean linen, and the fluid left to spontaneous fermentation. In other respects the process is the same as in making mead. Cleared in the cask, and racked into bottles, the wine will keep for more than 50 years. A cool cellar, at a temperature of 38 to 40° F., is an important factor. The bottles are placed in damp sand, which is moistened from time to time with salt water.

Kola.—Kola nuts, in coarse powder, 1 oz.; sherry wine, 30 oz. Macerate for 8 days, and filter. This wine may also be made with roasted kola nuts, which give a better tasting preparation, and it is none the worse for the addition of a little sugar.

Lemon Wine.—The fine-cut peel of 4 to 5 lemons is treated with sherry, 1,000 grams; cognac, 300 grams; and filtered after 24 hours. To the filterate add orange-flower water, 50 grams.

Madeira Wine.—1.—To 10 gal. prepared cider add 1 gal. Madeira wine; pure proof spirits, 3 qt.; brandy, 1 qt.; tartaric acid, ¾ to 1 oz.; oi lbitter almonds, ¼ dr., cut in ½ pt. alcohol; loaf sugar, 1½ lb. Allow it to stand for 2 weeks; rack, fine, and repeat if necessary.

2.—Pale malt, ground, 4 bu.; boiling water, 44 gal.; infuse, strain off this while warm; take 24 gal. and add: sugar candy, 14 lb.; cream of tartar, 3 oz.; when dissolved, add yeast, 2 lb.; ferment, keep skimming off the yeast, and when the fermentation is nearly finished add raisin wine, 2½ gal.; brandy and sherry wine, of each 2 gal.; rum, 1 qt.; bung it down for 6 or 9 months. A second infusion of the malt may be made for beer.

3.—Purified honey, 15 oz.; hop tops, ¾ oz.; alcohol, 90%, 19½ oz.; French wine, 4½ qt.; add ¾ oz. tincture burned sugar; filter.

Malmsey, British.—From sliced or grated parsnips, 4 lb.; boiling water, 1 gal.; when cold press out the liquid, and to each gal. add of cream of tartar, ½ oz., and good Muscovado sugar, 3 lb.; ferment, rack, and add of brandy 3 to 5%. Good Malaga raisins may be substituted for the sugar.

Mead, or Honey Wine.—Take 10 gal. of water, 2 gal. of strained honey, with 2 or 3 oz. of white Jamaica ginger root, bruised, and 2 lemons cut in slices. Mix all together, and boil for half an hour, carefully skimming all the time. Five minutes after the boiling commences add 2 oz. of hops. When partially cold put it into a cask to work off. In about 3 weeks after working it will be fit to bottle. This is a wholesome and pleasant beverage, particularly grateful in summer, when drunk mixed with water.

Medicated Wines.—Dieterich, in a late issue of his *Pharmaceutische Manual*, gives a number of formulae for the preparation of medicated wines. Few, if any, of these can be regarded as tipples, but all are peculiar for the fact that the wine from which they are made is detannated. We give a selection of the more important formulae for articles which should be salable if put up in attractive form and brought before customers in a nice way.

1.—Cascara Sagrada Wine.—White gelatine, in strips, 15 gr.; distilled water, 2½ dr.; dissolve by the aid of heat, and add to sherry wine, 28 oz. Shake well, set aside for some time, then add: Tasteless fluid extract of cascara sagrada, 1½ oz.; sugar, 1½ oz. Set aside in a cool place for 8 days, and filter. A similar wine, not free from the bitter principle of the bark, may be made by macerating 1½ oz. of cascara sagrada and 1½ oz. of sugar in 30 oz. of sherry for 8 days, and filtering. A *Rhamnus frangula* wine can be made in the same way.

2.—Cinchona Wine.—a.—White gelatine, 15 gr.; distilled water, 2½ dr.; sherry wine, 18 oz. Detannate in the manner directed above, and then add: Simple syrup, 6 oz.; tincture of cinchona, 6 oz. After 8 days, filter.

b.—May also be made with red wine, or direct from the bark, the quantities being: Gelatine, 15 gr.; distilled water, 2½ dr.; sherry wine, 30 oz.; cinchona bark, in coarse powder, 10 dr.; sugar, 1½ oz. Macerate for 8 days, and filter. In this case care must be taken to have the gelatine and wine reaction complete before adding the cinchona; otherwise the alkaloid may be thrown out by the tannin of the wine.

3.—Improved Quinine Wine.—Gelatine, 15 gr.; distilled water, 2½ dr.; dissolve, and add to sherry wine, 29½ oz. Shake, and set aside to clear; the nadd the following solution: Hydrochlorate of quinine, 30 gr.; dilute hydrochloric acid, 30 drops; water, ½ oz. After a week filter. This is double the strength given by Dieterich.

Moselle.—1.—British Red Moselle.—Malmsey, colored with clarified elderberry juice.

2.—British Sparkling Moselle.—From rich cider apples (carefully peeled and garbled), pressed with ¼ of their weight of white magnum bonum plums (previously stoned), and the juice fermented with 2½ lb. double refined sugar per gal., as champagne.

Mulbberry.—1.—Juice of the fruit, 10 gal.; or of mulberries, bruised, 15 gal.: water, 15 gal.; sugar, 35 gal.; boil and ferment, then add spirit, 2 or 3 gal.; red tartar, 7 oz.; cassia, ½ oz.; bitter almonds, ½ oz.

2.—Ripe mulberries, ripe apples, equal quantities; sugar or honey, 1 lb. to the gal. Express the juice, put it into a cask, and add the sugar; ferment with yeast, 1 qt. to every hhd.; catechu, ½ lb.; red argol, ½ lb.

Mulled Wine.—Take ¼ oz. bruised cinnamon, ½ nutmeg, grated, and 10 bruised cloves. Infuse them in ½ pt. boiling water for an hour, strain, and add ½ oz. white sugar. Pour the whole into 1 pt. hot port or sherry wine. This is a good cordial and restorative in low stages of fever, or in the debility of convalescence from fevers.

Muscatel, British.—As British sparkling Moselle, with some infusion of clary, or of the musk plant, to flavor it.

Orange.—1.—Two blood oranges are stuck with cloves, and the whole fruit is then covered with burgundy, 1,000 grams; cognac, 300 grams; 90% alcohol, 200 grams; filtered after standing for 4 days.

2.—The oranges must be perfectly ripe. Peel them and cut them into halves, crosswise of the cells; squeeze into a tub. The press used must be so close that the seeds cannot pass into the must. Add 2 lb. white sugar to each gal. sour orange juice, or 1 lb. to each gal. sweet orange juice, and 1 qt. water to each gal. of the mixed sugar and juice. Close fermentation is necessary. The resultant wine is amber-colored, and tastes like dry hock, with the orange aroma. Vinegar can be made from the refuse, and extract from the peels.

Peach.—Take of cold soft water, 18 gal.; refined sugar 25 lb.; honey, 6 lb.; white tartar, in fine powder, 2 oz.; peaches, 60 or 80 in number. Ferment, then add 2 gal. brandy. This will make 18 gal. The first division is to be put into the vat, and the day after, before the peaches are put in, take the stones from them, break them and the kernels, then put them and the pulp into the vat.

Pepsin Wine.—White gelatine, in strips, 15 gr.; distilled water, 2½ dr.; white wine, 25 oz. Detannate as described. At the same time mix together: Pepsin, 7 dr.; glycerine, 6 dr.; distilled water, 6 dr. Add to the wine, along with 40 minims of hydrochloric acid; macerate for 8 days, shaking occasionally; then filter.

Pineapple Wine.—A pineapple of about 500 grams and ¼ of a vanilla pod are cut up, and macerated with port wine, 1,300 grams; cognac, 200 grams; allowed to stand 2 days; filtered without strong pressure.

Port.—1.—Ripe fruit, 4 lb.; clear soft water, 1 gal.; sugar, 3 lb.; cream of tartar, dissolved in boiling water, 1½ oz.; brandy, 2 to 3%; flavoring as required. The addition of an equal quantity of fruit and sugar increases the strength.

2.—Add to 10 gal. prepared cider, 2 gal. genuine port wine, 2 qt. best cognac brandy, 1 pt. simple syrup, 1 lb. bruised raisins, 1 oz. tincture kino, ½ oz. extract rhatany, 3 qt. proof spirits. Allow it to stand for 2 weeks, rack, fine, and repeat, if necessary. Keep the wine cool.

3.—British Port, London Port, South ampton Port.—Red cape, 2 gal.; damson or elder wine, 1 gal.; brandy, ½ pt.; powdered kino, ½ oz.

4.—Strong old cider, 6 gal.; elderberry juice, 4 gal.; sloe juice, 3 gal.; sugar, 28 lb.; powdered exract of rhatany, 1 lb.; at time of racking add brandy, ½ gal.; good port wine, 2 gal.

5.—Good port, 12 gal.; rectified alcohol, 6 gal.; French brandy, 3 gal.; strong rough cider, 42 gal.; mix in a well sulphured cask.

6.—Port wine, 8 gal.; brandy, 6 gal.; sloe juice, 4 gal.; strong rough cider, 45 gal.; as the last.

7.—Cider, 24 gal.; juice of elderberries, 6 gal.; sloe juice, 4 gal.; rectified alcohol, 3 gal.; brandy, 1½ gal.; powdered rhatany, 7 lb.; isinglass, 4 oz., dissolved in 1 gal. cider; bung it down; in 3 months it will be fit to bottle, but should not be drunk until the next year; if a rougher quality is required the quantity of rhatany may be increased, or 5 or 6 oz. of alum, dissolved in water, may be added.

Quinine Wine.—Break into small pieces 1 oz. of sulphate of quinine and put it into a glass jar with 2 oz. of 90% alcohol; let the quinine infuse for 24 hours; add 1 qt. of claret, and let it remain thus for 12 days; then filter the wine through a felt bag, and bottle for use. The above quantity of quinine may be dissolved, without the addition of alcohol, in any of the following wines: Madeira, Marsala, Malaga, Lunel, or Alicant.

Raisin Wine.—1.—To each lb. of raisins allow 1 gal. of cold water, 2 lb. of good preserving sugar, 1 tablespoonful of yeast. Strip the raisins from the stalk, put them into a large boiler or clean copper, with the water, simmer gently for about 1 hour, then rub them through a sieve. Dissolve the sugar in the liquid, and add the raisin pulp and the yeast, let the vessel stand covered for 3 days, then strain the liquid into a cask. Bung loosely until fermentation ceases, then tighten the bung, and allow the cask to stand for at least 12 months before racking the wine off into bottles.

2.—With Cider.—Good cider, 8 gal.; Malaga raisins, 15 lb.; French brandy, 1 bottle; sugar candy, 3 oz.; the rind of 3 lemons. Strip the raisins from the stalks, halve them, put them into a 9-gal. cask, and pour over them the cider. Bung lightly for 5 or 6 days, then tighten the bung and let the cask stand for 6 months.

3.—Raspberries, 6 qt.; red currants, 4 qt.; water, 10 qt.; good preserving sugar, 10 lb.; French brandy, 1 pt. Strip the red currants from the stalks, put them into a large earthenware or wooden vessel, and pour over them the water (which must have been previously boiled, and allowed to become quite cold). On the following day crush the red currants with a wooden mallet or potato masher, add the raspberries, and allow the whole to stand until the following day. Strain the liquid through a jelly bag or fine hair sieve, and drain the fruit thoroughly, but do not squeeze it. Stir in the sugar, and when quite dissolved turn the wine into a clean, dry cask. Bung loosely until fermentation has entirely subsided, then tighten the bung, and allow the cask to remain undisturbed for 3 months. At the end of this time rack the wine off carefully, straining that near the bottom of the cask repeatedly until quite clear. Scald and drain the cask, replace the wine, add the brandy, bung lightly, let it remain 2 months longer in the cask, and then bottle.

Raspberry Wine.—1.—Ripe raspberries, 10 qt.; boiling water, 10 qt.; good preserving sugar, 6 lb.; brewer's yeast, 2 tablespoonfuls; French brandy, 1 pt.; isinglass, ¼ oz. Prepare the fruit in the usual way, put it into an earthenware or wooden vessel, pour over it the boiling water, and let it remain covered until the following day. Pass both liquid and fruit through a fine hair sieve, let it stand for 24 hours, then strain it carefully, without disturbing the sediment, into another vessel. Add the sugar, stir in the yeast, and as soon as the sugar is dissolved turn the whole into a clean, dry cask. Cover the bunghole with a folded cloth until fermentation subsides, then bung it closely. Let it stand for 1 month, rack it off into a clean cask, add the brandy, and isinglass dissolved in a little warm water, bung tightly, and allow it to remain undisturbed for 12 months. At the end of this time rack it off into bottles, cork them securely, store for 12 months longer, and the wine will be ready for use.

2.—Put 6 qt. of ripe raspberries into an earthenware or wooden vessel, bruise them well with a heavy wooden spoon, and pour over them 6 qt. of cold water. Let them stand until the following day, stirring them frequently, then strain the liquid through a jelly bag or fine hair sieve, and drain the fruit thoroughly, but avoid squeezing it. Measure the liquid; to each qt. add 1 lb. loaf sugar; stir occasionally until dissolved, then turn the whole into a cask. Bung loosely for several days, until fermentation ceases, then tighten the bung; let it remain thus for 3 months, and bottle for use.

Red Wine.—Cider, 16 gal.; honey, 27 lb.; tartar, red, 8 oz.; raw sugar, 3 lb.; sliced red beet, 6 lb.; boil, ferment, and add: Cassia, ½ oz.; ginger, ½ oz.; spirit, 5 qt.

Rhubarb Wine.—1.—Rhubarb, 25 lb.; cold water, 5 gal.; to each gal. of liquid thus obtained add 3 lb. of either loaf or good preserving sugar and the juice and very thinly pared rind of 1 lemon; to the whole add 1oz. of isinglass. Wipe the rhubarb with a damp cloth and cut it into short lengths, leaving on the peel. Put it into an earthenware or wooden vessel, crush it thoroughly with a wooden mallet or heavy potato masher, and pour over it the water. Let it remain covered for 10 days, stirring it daily; then strain the liquor into another vessel, add the sugar, lemon juice and rind, and stir occasionally until the sugar is dissolved. Now put it into a cask, and add the isinglass, previously dissolved in a little warm water; cover the bunghole with a folded cloth for 10 days, then bung securely, and allow it to remain undisturbed for 12 months. At the end of this time rack off into bottles, and use.

2.—Rhubarb, 20 lb.; cold water, 5 gal.; loaf or good preserving sugar, 12 lb.; French brandy, 1 pt.; barley sugar, ½ lb.; isinglass, ½ oz.; the rind of 2 oranges; the rind of 2 lemons. Wipe the rhubarb with a damp cloth, slice it thinly, put it into a large earthenware or wooden vessel, pour over it the water, and let it stand, closely covered, for 4 days. Strain the liquid through a jelly bag or fine sieve, pressing the pulp as dry as possible without allowing any of it to pass through the sieve. Add the sugar, stir occasionally until dissolved, then turn the preparation into a cask and cover the bunghole with a folded cloth. As soon as fermentation subsides add the brandy. Bung the cask securely, and allow it to remain undisturbed for 3 months. Rack the wine into a clean, dry cask, add the very finely pared rind of the oranges and lemons, the barley sugar, finely powdered, and the isinglass dissolved in a little warm water Bung the cask securely, store in a cool, dry place for at least 12 months, then bottle, cork securely, store for 6 months longer, when the wine will be ready for use.

Senna Wine.—Leaves of Alexandrian senna, 1½ oz.; sherry wine, 27 oz. Macerate for 8 days, press and strain; then add 5 gr. of gelatine, dissolved in 2½ dr. of distilled water, and then the following: Tincture of orange peel, 1 oz.; tincture of ginger, ½ oz.; aromatic tincture, 80 minims; honey, 2 oz. Again allow to stand for 10 days, and filter. This wine is an excellent aperient for persons suffering from hemorrhoids.

Sherry Wine.—1.—To 8 gal. prepared cider add: Best sherry wine, 6 qt.; native wine, 1 gal.; oil of bitter almonds, ¼ dr., cut in ½ pt. of alcohol; proof spirits, 3 gal.; sugar, 1 lb.; saffron to color. Let the wine stand for 10 days; rack, and fine.

2.—Cape or raisin wine, slightly flavored with a very little bitter-almond cake, or, what is more convenient, a little of the essential oil, dissolved in alcohol (essence of bitter almonds).

3.—To the last add a minute quantity of sweet brier, eau de fleurs d'oranges, or orris, to give it a very slight bouquet.

4.—To each gal. of strong raisin must add, when racking, 1 Seville orange and 2 bitter almonds, both sliced. By omitting the almonds and adding 2 or 3 green citrons to each 10 gal. this forms British Madeira:

5.—Loaf sugar, 32 lb.; sugar candy, 10 lb.; water, 16 gal. Boil; add pale ale wort (as for Madeira), 6 gal.; yeast, 1 lb.; on the third day add raisins, stoned, 10 lb.; and in another 2 or 3 days brandy, 1 gal.; bitter almonds, grated, 1 dr.; bung it down for 4 months, draw it off into another cask, add brandy, 1 gal., and in 3 months bottle it. Teneriffe, slightly flavored with cherry laurel, or almonds, forms a most excellent British sherry, either alone, or diluted with an equal quantity of cape or raisin wine.

6.—From Sour Grapes.—The way an imitation sherry is made in England is to mix equal quantities of new cider and honey, and evaporate to a density so that a fresh egg will float so as to be half immersed. The liquid is then cooled and kept in a stone vessel at a temperature of from 60 to 67° F., until in about 12 or 14 days the peculiar smell of the fermentation is strongly established; then the liquid is put into a barrel, closed up, and placed in a cool cellar o settle; after 3 or 4 days it will be cleared; it is then bottled, and six weeks later is fit for drinking. We believe that grape juice may be used in place of cider, but if too acid, sugar and water would only make a kind of lemonade, and spoil the sherry taste, which is not acid. Sugar does not destroy this, but sulphite of lime is the proper material (not sulphate).

Strawberry Wine.—1.—Take of cold, soft water, 7 gal.; cider, 6 gal.; strawberries, 6 gal. Ferment. Mix raw sugar, 16 lb.; red tartar, in fine powder, 3 oz.; the peel and juice of 2 lemons; then add 2 or 3 qt. of brandy. This will make 18 gal.

2.—Take of cold, soft water, 10 gal.; strawberries, 9 gal. Ferment. Mix raw sugar, 25 lb.; red tartar, in fine powder, 3 oz.; 2 lemons and 2 oranges, peel and juice; then add 1 gal. of brandy. This will make 18 gal.

Tokay, British.—To good cider, 18 gal., add of elderberry juice, ½ gal.; honey, 28 lb.; sugar, 14 lb.; red argol, in powder, ¾ lb.; crystallized tartaric acid, 3 oz.; mix, boil, ferment; and when the active fermentation is complete add of brandy, 1 gal., and suspend in the liquid from the bunghole a mixture of cassia and ginger, of each ½ oz.; cloves and capsicum, of each ¼ oz.; the whole bruised, and loosely enclosed in a coarse muslin bag. It will be ripe in 12 months.

White Wine.—Cider, 100 gal.; honey, 80 lb.; sugar, 20 lb.; mix, and ferment; add spirit, 6 gal.; white tartar, 1½ lb.; bitter almonds, bruised, 1 oz.

Yeast Wine.—Pour 100 parts of watter in which 12 to 14 parts of white loaf sugar have been dissolved on to 40 parts of fresh wine yeast, and allow the whole to ferment at 41° F. The fermented wine is drawn off from the yeast, and may be further fortified by the addition of spirits.

CHAPTER VI

CEMENTS, GLUES, PASTES, MUCILAGES AND ALL ADHESIVES

GENERAL SCHEME OF CLASSIFICATION

CEMENTS PROPER

- ACID-PROOF
- AQUARIUM
- BARRELS AND CASKS
- BUILDING
- CASEIN
- CELLULOID
- DENTAL
- GLASS, ETC.
- JEWELERS'
- LEATHER
- MECHANICS'
- METALS
- METALS TO GLASS, ETC.
- METALS TO LEATHER, ETC.

CEMENTS PROPER—Continued

- MICROSCOPISTS'
- RUBBER
- WOOD TO WOOD
- MINOR USES

OTHER ADHESIVES

- GLUE
- LUTES
- MUCILAGE
- PASTES
- PASTTES OR SPECIAL USES
- PUTTY
- SPECIAL ADHESIVES

The importance of cements, both in the workshop and in the household, is universally acknowledged, but the frequency of failures in the use of them shows that no matter how good the receipt, or how carefully compounded, if the cement is carelessly applied or allowed an insufficient time for setting, bad results are sure to follow. By observing the following simple rules much time and money can be saved.

1.—See that the surfaces are clean. Dirt and grease are sure to breed trouble. Wash the article with lye (caustic potash), or if from the nature of the substance lye cannot be used, with carbon bisulphide. The hands are very liable to be greasy, and the edges to be joined should not be touched by them. If the substances to be united have been joined before, all traces of the former cement must be removed.

2.—Bring the cement into intimate contact with the surfaces to be united. This is best done by heating the pieces to be joined in those cases where the cement is melted by heat, as in using rosin, shellac, marine glue, etc. This heating is of great importance and is usually neglected, to the detriment of the strength of the joint. This fact is understood by cement peddlers, and some of the really marvelous feats performed by them are entirely owing to this cause. Where solutions are used the cement must be well rubbed into the surfaces, either with a soft brush (as in the case of porcelain or glass) or by rubbing the two surfaces together (as in making a glue joint between two pieces of wood).

3.—As little cement as possible should be allowed to remain between the united surfaces. To secure this the cement should be as liquid as possible (thoroughly melted if used with heat), and the surfaces should be pressed closely into contact (by screws, weights, wedges or cords), until the cement has hardened. These mechanical aids also help to displace the thin film of air which sticks closely to the substance. The ordinary carpenter's hand screw is recommended for use with cements. It is in use by all cabinet makers and carpenters for gluing. A string tightly bound about the object answers the same purpose and is good if tight. All excess should be removed from the edges while the cement is still liquid. Plenty of time should be allowed for the cement to dry or harden, and this is particularly the case in oil cements, such as copal varnish, boiled oil, white lead, etc. When 2 surfaces, each ½ in. across, are joined by means of a layer of white lead placed between them, 6 months may elapse before the cement in the middle of the joint has become hard. In such cases a few days or weeks are of no account; at the end of a month the joint will be weak and easily separated, while at the end of 2 or 3 years it may be so firm that the material will part anywhere else than at the joint. Hence when the article is to be used immediately the only safe cements are those which are liquefied by heat and which become hard when cold. A joint made with marine glue is firm an hour after it has been made. Next to cements that are liquefied by heat are those which consist of substances dissolved in water or alcohol. A glue joint sets firmly in 24 hours; a joint made with shellac varnish becomes dry in 2 or 3 days. Oil cements, which do not dry by evaporation, but harden by oxidation (boiled oil, white lead, red lead, etc.), are the slowest of all.

4.—Coloring matters may be introduced into cements with good effect. But care should be used not to mix anything with the cement which will set up any chemical action and so weaken the joint.

5.—Select the right recipe from the following very full list of cements, which contains all which are of value and many which are published for the first time. A good rubber cement, shellac varnish and a good gutta percha cement as the following should be on every amateur's work table.

A Strong and Handy Cement.—One of the strongest cements, and very readily made, is obtained when equal quantities of gutta percha and shellac are melted together and well stirred. This is best done in an iron capsule placed on a sand bath and heated either over a gas furnace or on the top of a stove. It is a combination possessing both hardness and toughness—qualities that make it particularly desirable in mending crockery. When this cement is used, the articles to be mended should be warmed to about the melting point of the mixture, and then retained in proper position until cool, when they are ready for use.

ACID-PROOF CEMENTS

1.—Acid-proof cements are used for cementing troughs or other objects intended to hold acid.

2.—For Galvanoplasty.—An oaken trough, close made, will last from 12 to 15 years if coated with Burgundy pitch, 1.500 grams; old gutta percha in shreds, 250 grams; pounded pumice, 750 grams. Melt the gutta percha, mix with the pumice and add the pitch. A hot iron passed over the surface smooths it and assists adhesion. The box resists suphate of copper baths, but not cyanide.

3.—Melt together pitch, 1 part; rosin, 1 part, and plaster of paris (perfectly dry), 1 part.

4.—A good acid-proof cement is made by mixing a concentrated solution of silicate of soda with powdered glass to form a paste. This is useful for luting joints in vssels exposed to acid fumes.

5.—A mixture of china clay and boiled linseed oil, in the proportions needed to produce the right consistency.

6.—Quicklime and linseed oil, mixed stiffly together, form a hard cement, resisting both heat and acids.

7.—A stiffly mixed paste of pipeclay and coal tar.

8.—A cement which, according to Dr. Wagner, is proof against even boiling acids, may be made by a composition of India rubber, tallow, lime and red lead. The India rubber must first be softener by a gentle heat and then 6 to 8% by weight of tallow is added to the mixture while it is kept well stirred; next dry slaked lime is applied until the fluid mass assumes a consistency similar to that of soft paste; lastly 20% of red lead is added, in order to make it harden and dry.

9.—Sulphur, 100 parts; tallow, 2 parts: rosin, 2 parts. Meut, add sifted ground glass.

10.—Rosin, 1 part; sulphur, 1 part; brick dust, 2 parts: the whole is melted after careful mixing. This lute is proof against the attacks of nitric and hydrochloric acid vapors

11.—Melt 1 part of pure rubber in 2 parts of linseed oil; add 6 parts of pipeclay. This mixture produces a plastic cement which softens by heat, but does not melt.

12.—Rosin, 3 lb.; dried red ocher, ½ lb.; calcined plaster of paris, ¼ lb.; linseed oil, ⅛ lb. These must be incorporated by stirring together when melted.

13.—Have boxes perfectly dry; smear them inside with a hot mixture of 4 parts rosin, 1 part gutta percha and a little boiled oil. The mixture must be thoroughly melted and stirred before use. A hot rod of iron may be used to melt it into the crevices. They can be used for any ordinary type of battery.

14.—Melt over a water bath 2 parts tallow and gradually add until all is dissolved 30 parts pure rubber. When thoroughly melted add 2 parts of slaked lime.

15.—*Asbestos.*—Ground asbestos may be made into a cement which will stand a high degree of heat by simply mixing it with a solution of sodium silicate. By subsequent treatment with a solution of calcium chloride the mass may be made insoluble, silicate of calcium being formed.

a.—Asbestos, 2 parts; barium sulphate, 3 parts; sodium silicate, 2 parts; mix. This cement will resist the strongest nitric acid. If hot acids are dealt with, the following will be found to possess still more resistant powers: b.—Sodium silicate, 2 parts; fine sand, 1 part; asbestos powder, 1 part. Both these cements take a few hours to set. If the cement is wanted to set at once, use potassium silicate instead of sodium silicate.

b.—Mix 1 part each of asbestos and fine sprinkling sand and 3 to 4 parts of soda water glass (30° Be). The mass is plastic, speedily dries in the air and is fireproof. After being exposed to the acids kept in these vessels, the mass is waterproof. After being exposed to the be softened in water.

AQUARIUM CEMENTS

1.—Whiting, 6 parts; plaster of paris, 3 parts; white beach sand, 3 parts; litharge, 3 parts; powdered rosin, 1 part. Mix thoroughly and make into a putty with the best coach varnish. Leave the glass a week before disturbing.

2.—Linseed oil, 3 oz.; tar, 4 oz.; rosin, 1 lb.; melt together over a gentle fire. If too much oil is used, the cement will run down the angles of the aquarium; to obviate this it should be tested before using by allowing a small quantity to cool under water; if not found sufficiently firm, allow it to simmer longer or add more tar and rosin. The sement should be poured in the corners of the aquarium while warm (not hot). This cement is pliable and is not poisonous.

3.—Take litharge, 10 parts by measure; plaster of paris, 10 parts; dry white sand, 10 parts; finely powdered rosin, 1 part, and mix them when wanted for use into a pretty stiff putty with boiled linseed oil. This will stick to wood, stone, metal or glass and hardens under water. It is also good for marine aquaria, as it resists the action of salt water. It is better not to use the tank until 3 days after it has been cemented.

4.—Gypsum, 2 parts; chalk, 2 parts; litharge, 2 parts; powdered rosin, 1 part. Mix with boiled linseed oil until a mass resembling glazier's putty results. An excellent material for tightening aquaria has been found to be a mixture of litharge and glycerine, which turns as hard as stone within a few hours.

5.—Gutta percha, in shreds, 4 oz.; black pitch, 8 oz.; shellac, 2 dr. Melt in an iron ladle on a sand bath and stir together. Pour out on a wet slab and roll into sticks.

6.—The following is given by Dieterich: Litharge, 20 parts; white sand, finest, 20 parts; plaster f paris, 20 parts; manganese borate, 1 part; rosin, powdered, 70 parts; boiled linseed oil, q. s. Mix the solids and make them into a paste with the oil.

BARRELS AND CASKS

1.—*Brewers' Cement for Coating.*—The following compound is recommended as a good and cheap substitute for brewers' pitch: Coat twice the inside of a barrel with a solution of rosin, ½ lb.; shellac, 2 oz.; turpentine, 2 lb., and yellow wax, ½ oz., in 1 qt. of strong alcohol. After the complete drying of the second coat give a last coat by applying a solution of 1 lb. shellac in 1 qt. of strong alcohol. This varnish will perfectly cover up the pores and does not crack off or impart a foreign taste to the beer.

2.—*Cement for Closing.*—Tallow, 5 parts; wax, 4 parts; lard, 8 parts; wood ashes, sifted, 5 parts. Apply with heat.

3.—*Leaking Barrels.*—Melt at a low heat a mixture of lard, 30 parts; rock salt, 30 parts; wax, 10 parts, and paraffine, 6 parts. To this add 25 parts finely sifted wood ashes. This cement is applied warm over the leaky places.

4.—*Massiat's Cement for Covering Bungs.*—Melt rubber with 10 to 20% tallow or beeswax. Gradually add finely pounded quicklime.

5.—*Wax Putty for Leaky Casks, Bungs, etc.*—Yellow wax, 4 lb.; tallow, 2 lb.; spirits of turpentine, 1 lb.; solid turpentine, 6 lb. Melt the wax and solid turpentine over a gentle fire; add the tallow. When melted take entirely away from the fire, add the spirits of turpentine, let it cool.

BRISTLES IN HAIR BRUSHES, SETTING FOR

1.—Pitch or shellac, 1 to 2 parts; gutta percha, 1 part. Melt together, stirring until thoroughly incorporated, then pour into cold water. When cold this is a black elastic mass, softening with heat.

2.—Rosin, 2 parts; yellow wax, 2 parts; burnt ocher, 2 parts. Melt the rosin with the wax and stir in the ocher which should be in a very fine state of division. Keep the mass heated to a fluid until ready to pour into the form.

3.—Slaked lime, powdered, 54 parts; powdered alum, 6 parts; fresh beef blood, strained, 40 parts. Mix the powders and stir them intimately into the blood.

BUILDING CEMENTS

1.—To 1 heaped bushel of mortar, made in the ordinary way, add 3½ qt. (dry measure) of iron scale and 1½ qt. of molasses. Use the same day.

2.—*Blood Cement, Pointing for Bricks.* —a.—Slaked lime, 50 parts; beaten bullock's blood, 40 parts; alum, 1 part; mix.

b.—Slaked lime, 50 parts; fine ashes, 25 parts; bullock's blood, 8 to 10 parts.

3.—*Building Stone, Cheap.*—Plaster of paris, 20 parts; hydraulic lime, 2 parts; liquid glue, 1 part; water, 100 parts; pour into molds when hard; dry in the air for 2 weeks.

4.—*English Roman Cement.*—Take a bushel of lime slaked with 3½ lb. of green copperas, 15 gal. of water and ½ abushel of fine gravel sand. The copperas should be dissolved in hot water; it must be stirred with a stick and kept stirring continually while in use. Care should be taken to mix at once, as much may be requisite for one entire front, and it is very difficult to match the color again. It ought to be mixed the same day it is used.

5.—*Facing Putty.*—Mix whiting, some white lead and a small quantity of litharge. Then add a small quantity of drying oil. This putty is especially good for stopping small flaws.

6.—*Floors.*—a.—For cellar bottoms use 5 parts of clean, coarse, sharp sand (plasterers call it fine gravel) to 1 part of cement. It only requires to be damp enough to work well. It is mixed in a box, wheeled into cellar, dumped, and spread smooth with a shovel, hoe or trowel, about 2 in. thick. Take a spade or shovel, flat side, and beat it down hard and smooth. For finishing, use 1 part of cement to 1 part of sand; this is thoroughly mixed, and then watered so it is like plastering mortar. Dump it on the first coat, about ½ in. hick, spread and smooth with a trowel. It will soon become as hard as stone. The cement is known as Portland cement, though the common hydraulic cement will answer if fresh.

b.—Mix 6 parts of plaster of paris with 1 part of lime; wet, slake, and lay the floor. Then go over it after it is dry with a solution of copperas. This is repeated several times. The surface must be perfectly dry before each application. Finally, after some days' drying, brown with boiled linseed oil, and finally varnish with copal varnish. The floor may have to be laid in sections, on account of the expansion on setting. The iron oxide turns brown on exposure to the air.

7.—*Granite Works, Filling in.*—A filling that is used to fill up holes and to patch up nicked corners, etc., in granite monuments is made by melting gum dammar in a shallow vessel, over a water bath, so as not to burn it. When quite thin, stir in granite dust, and add enough marble dust to lighten it to the color of the granite. Stir in all the dust the gum will easily hold; roll out in long sticks, and it is ready for use. To apply, heat an iron red hot, and hold it over the stone, and at the same time hold the stick near the monument, and it will melt, and can then be pressed into the cavity. When cold, pare down with a sharp tool, and touch it up lightly with a bush hammer or chisel.

8.—*Hamelin's Mastic, for Covering Buildings.*—Silicious sand, 60 parts; Bath or Portland stone (in fine powder), 40 parts; lime marl, 20 parts; litharge, 8 parts; ground together. For use, it is mixed up with linseed oil, and used like mortar. When this cement is applied to the purpose of covering buildings intended to resemble stone the surface of the building is first washed with linseed oil.

9.—*Hydraulic Cement.* — a. — Burnt brick, 63 parts; litharge, 7 parts. Use with linseed oil. Wet the surfaces to be cemented.

b.—Gad's.—Clay, well dried and powdered, 3 parts; oxide of iron, 1 part; mixed together, and made into a stiff paste with boiled oil. Used for work required to harden under water.

c.—Turkish Plaster or Hydraulic Cement.—Fresh lime (reduced to powder), 150 lb.; linseed oil, 15 qt.; cotton, 1½ to 3 oz. Gradually mix the oil and cotton into the lime until the mixture is of the consistency of bread dough. Mix in a wooden vessel. Dry the mixture, and, when used, form a paste by mixing with linseed oil. Put on in coats. Used to coat water pipes of clay or metal.

10.—*Linseed-Oil Cements, for Jointing Stones, etc.*—Linseed oil, 25 parts; boil with 35 parts of litharge and 350 parts of finely powdered burned lime. Use hot.

11.—*Martin's.*—This is manufactured in the same way as Keene's, only carbonate of soda or carbonate of potash is used, as well as alum, and the burning is carried on at a higher temperature.

12.—*Metallic Cement.*—(See *Stone Repairing.*)

13.—*Parian Cement.*—Also made in the same way as Keene's, but with the use of a solution of borax, the biborate of soda, in place of alum. All these cements are capable of receiving a high degree of polish, and as they dry very rapidly, can be painted over within a few days.

14.—*Pen's Cement for Covering Buildings, etc.*—Powdered quicklime, 1 part; powdered baked clay, 2 parts; mix, then add 1 part of freshly baked and powdered gypsum to 2 parts of powdered baked clay; and after mixing well, add them to the former powder, and thoroughly incorporate the two. It is mixed up with water and applied like mortar. It acquires great hardness, and is very durable.

15.—*Pointing for Buildings.*—Use equal parts of hydraulic cement (Portland), lime, and fine white sand.

16.—*Portland Cement.*—It derives its name from its supposed resemblance to Portland stone when used as a stucco upon walls. The materials required in its manufacture are chalk, or any other "rich" limestone, river mud, or clay, and oxide of iron, the proportions in which these materials are mixed varying at different works—from 65 to 80% of limestone and 20 to 35% of clay and iron oxide, which are intimately mixed with water in a mill, then dried slowly on hot plates, and afterward calcined in a kiln and reduced to fine powder. Before being used, the cement should be kept for some months in a dry place, as its cohesive strength is thereby increased. It hardens rapidly when stirred up with water, and possesses great cohesive power, which is diminished by the admixture of sand. When used as a stucco it can be mixed with 3 or 4 parts of sand to 1 of cement, and the setting then proceeds more slowly than if pure cement is used. The sand must be perfectly free from loamy particles, otherwise it will not harden, but will crumble to pieces at the touch. If painted over with oil color soon after it has been laid on a wall it will peel off and form blisters, probably from the large proportion of quicklime it contains not being thoroughly slaked before it hardened. Some months, therefore, should be allowed to elapse before paint is applied to it.

17.—*Roman Cement.*—This consists of pulvis Puteolanus or pozzuolana, a ferruginous clay from Puteoli, calcined by the fires of Vesuvius, lime and sand, mixed up with soft water. The only preparation which the pozzuolana undergoes is that of pounding and sifting; but the ingredients are occasionally mixed up with bullock's blood and fat of animals, to give the composition more tenacity.

18.—*Roman Cement.*—Ordinary clay, 60 lb.; calcine, and mix with 40 lb. lime; recalcine the whole.

19.—*Roofs.*—a.—Melt together in an iron pot 2 parts by weight of common pitch and 1 part gutta percha. This forms a homogeneous fluid much more manageable than gutta percha alone. To repair gutters, roofs, or other surfaces, carefully clean out of the cracks all earthy matters, slightly warm the edges with a plumber's soldering iron, then pour the cement, in a fluid state, upon the cracks while hot, finishing up by going over the cement with a moderately hot iron, so as to make a good connection and a smooth joint. The above will repair zinc, lead or iron, and is a good cement for aquariums.

b.—Rosin, 4 lb.; linseed oil, 1 pt.; red lead, 2 oz.; stir in fine sand until the proper consistency is securd, and apply warm. This cement becomes hard, and yet possesses considerable elasticity, is durable and waterproof.

20.—*Roofs, Tile.*—Dry sand and whiting, equal parts; litharge, 25%. Make of the consistency of putty, with linseed oil. This cement is not liable to crack when cold, or melt, like tar or asphalt, with the heat of the sun.

21.—*Sandstone, Cement for.*—Clean sand, 10 parts; lead oxide, 1 part; ground lime, ½ part; mix with linseed oil.

22.—*Stone Repairing, Metallic Cement for.*—The following recipe is given by Professor Brune, of the School of Fine Arts. It was used in the restoration of the colonnade of the Louvre, of the Point Neuf, and of the Conservatoire des Arts et Metiers. It consists of a powder and a liquid. The powder: 2 parts by weight of oxide of zinc, 2 parts of crushed limestone of a hard nature, and 1 part of crushed grit, the whole intimately mixed and ground. Ocher in suitable proportions is added as a coloring matter. The liquid: A saturated solution of zinc in commercial hydrochloric acid, to which is added a part, by weight, of hydrochlorate of ammonia equal to 1-6 that of the dissolved zinc. This liquid is diluted with 2-3 of its bulk of water. To use the cement, 1 lb. of powder is to be mixed with 2½ pt. of the liquid. The cement hardens very quickly, and is very strong.

23.—*Stonemason's Cement.*—Clean river sand, 20 lb.; litharge, 2 lb.; quicklime, 1 lb.; linseed oil, sufficient to form a thick paste. This cement is applied to mend broken pieces of stone, and after a time it becomes exceedingly hard and strong.

24.—*Terra Cotta.*—Coat the terra cotta after heating, and apply the cement as soon as possible. The cement is made as follows: Rosin, 10 parts; yellow wax, 10 parts; sulphur, 2 parts. Melt these together and add 1 part each of hammer slag and quartz sand. Point up the edges of the joint with pounded terra cotta.

Articles on the Manufacture, Chemistry, Testing, Hardening, etc., of Building Cements are contained in the Scientific American Supplement, Nos. *1433, *1465, *1466, 1491, 1510, 1511, 1533, 1561, 1575, 1587, 1588, 1590, 1679, 1723 and 1724. For voluminous data on Concrete and Reinforced Concrete Construction of Dewellings, Farm Buildings, Walks, Posts, etc.; Engineering Structures, Computation, Formula for Floors, Beams, Columns, etc.; Proportioning, Mixing, Selecting of Sand and Aggregates, Surface Treatment, Waterproofing, etc., see our Scientific American Supplement, Nos. *1547, *1548, 1551, 1564, 1565, *1567, 1568, *1569, *1570, *1571, *1573, *1575, *1576, *1577, 1580, 1581, 1583, 1586, 1591, 1595, 1596, 1605, *1608, 1624, 1626, *1634, 1658, *1673, *1685, *1721, *1773, *1687 and 1778. (*) Indicates illustrated articles

Concrete.

1.—A good concrete is used in France for building purposes that possesses the necessary qualities of solidity and hardness. It is composed of 8 parts of sand, gravel and pebbles; 1 part of common earth, burned and powdered; 1 part of powdered cinders and 1½ parts of unslaked hydraulic lime. These materials must be thoroughly beaten up together; their mixture, when properly moistened, gives a concrete which sets almost immediately, and becomes in a few days extremely hard and solid, properties which may be still further increased by the addition of a small quantity—say 1 part—of Portland cement. It is stated that many large buildings have been constructed of this material in France—in one case a house 3 stories in height, 65 x 45 ft., standing on a terrace, having a retaining wall built perpendicularly 20 ft. high and 200 ft. in length. Every part of this structure was made of hard concrete, including foundations, vaults of cellars, retaining wall, and all walls, exterior and interior, as well as the cornice work, moldings, string courses, parapets and balustrades, and the building has no band iron in the quoins, or other plan to bind it together. All lintels over doors and windows and sills are composed of the same materials, being cast in molds.

2.—a.—Coarse sand, 5 parts; pebbles, 12 parts; lime, 3 parts.

b.—Pebbles, 16 parts; river sand, 8 parts; lime, 2 parts.

3.—*Brickwork.*—Slaked lime, 7 parts, by measure; sand, 12 parts.

4.—*Coignet Beton.*—Slaked lime, 7 parts, quicklime, 1 measure; hydraulic cement, ¼ to ½ measure.

5.—*Floors.*—To make a permanent pavement, excavate to the depth of 2 ft., and lay in the largest stone you can procure, 1 ft. deep. Fill in upon this bed enough small stones of egg size to level it very smooth, carefully filling all the interstices between the large stones. Now procure a quantity of carse gravel, entirely free from loam, and fill in up to within 6 in. of the surface. Let this remain in this condition until it has undergone a thorough settling and packing, by being subjected to a heavy rain. You will now have a solid, substantial bed for your concrete, which may be made as follows: To 3 lb. of clear, sharp sand add 1 bbl. of good cement, dry. Thoroughly incorporate, then sprinkle enough water upon the mixture to make a paste, stirring it well. To this paste add 2 bbl. of stone chips and 2 bbl. of coarse gravel, but only as much, however, as the paste will take up. Mix thoroughly, and deposit it immediately on the bed, letting it fall from the barrow, and leveling it off to its proper height. The whole floor should be covered with as little delay as possible, and when laid should be compressed by a rammer such as is used by street pavers. Finish with a thin coat of pure cement mortar, to bring the surface to complete evenness, and do not let it dry too quickly, but wet it occasionally, so that it may have all the water it will absorb.

6.—*Foundations.*—Five parts gravel and sand to 1 part fresh-burned stone lime, ground to powder, without slaking, and measured dry. Well turn and shovel together, with sufficient water to slake the lime into the state of very thick mortar. Chips and small pieces of stone may be added with advantage.

7.—*Marble.*—Very finely powdered marble, or white limestone, is mixed with milk of lime until a smooth paste is formed. Some powdered limestone may now be added, and the mixture used at once.

8.—*Masonr.*—a.—Screened sand, 9 parts by measure; slaked lime, 7 parts; forge ashes, 1 part; pozzuolana, 1 part.

b.—Slaked lime, 1 part; sea sand, 1 part; furnace ashes, ¼ part.

Marble, To Cement.

1.—Melt together 8 parts of rosin and 1 of wax; when melted, stir in 4 or 5 parts of plaster of paris. The pieces to be joined should be made hot.

2.—Procure a small piece of quicklime fresh from a newly burnt kiln, slake with the white of an egg, wash the fractured parts quite clean, and apply.

3.—Soak plaster of paris in a saturated solution of alum, bake in an oven, reduce it to a powder, mix with water, and apply; it sets like granite.

4.—Mix 12 parts of Portland cement, 6 parts of slaked lime, 6 parts of fine sand and 1 part of infusorial earth, and make up into a thick paste with silicate of soda. The object to be cemented does not required to be heated. It sets in 24 hours, and the fracture cannot be readily found.

5.—Make a thick mucilage of 1 oz. of gum arabic, add 1½ oz. dental plaster, and finally ½ oz. finely powdered quicklime; mix well. When required for use heat the marble.

6.—Coat the marble with linseed-oil varnish, then apply the following cement: Brick dust, 10 parts; litharge (elutriated), 1 part; linseed-oil varnish, 2 parts; work up into a stiff putty.

7.—Mix litharge and freshly burned lime in the proportion 20 to 1. Make into a putty with q. s. of linseed oil.

8.—Lac, colored to imitate the marble; may be mixed with marble dust passed through a silken sieve.

9.—W. F. Reid gives the following details for it. Begin with the raw gypsum in lumps of moderate size, burning them at the usual temperature (below red heat). The solution of alum should contain 1 part of this salt in 10 parts of water. There is no difficulty in dissolving this quantity if the water be previously heated and the alum coarsely pulverized. By immersing the lumps of burnt gypsum in this solution while they are still warm, and leaving them in it for about 15 minutes, they will become thoroughly saturated with the liquid. They should then be allowed to drain, and again burnt, but this time at a red heat. Gypsum which has been treated in this way forms, when pulverized, a slow-setting cement which ultimately attains great hardness, and has frequently been used for making paving tiles, especially in Italy.

10.—Into a solution of chloride of zinc, 1.490 to 1.652 sp. gr., is introduced 3% of borax or sal ammoniac; when this is dissolved oxide of zinc, which has been subjected to a red heat, is added, till the mass attains the desired consistency. This cement becomes as hard as marble, and may be used for molding.

11.—Portland cement, 12 parts; slaked lime, 6 parts; fine sand, 6 parts; infusorial earth, 1 part; mix into a thick paste with silicate of soda, The object to be cemented need not be warmed. The cement sets in 24 hours, and the fracture can then hardly be detected. The cemented portions are harder than the rest, and the fracture cannot by any chance be reopened.

12.—*Keene's Marble Cement.*—Baked gypsum or plaster of paris, steeped in a saturated solution of alum, and then recalcined and reduced to powder. For use, mix up with water the same as plaster of paris. This important cement will not stand the weather, but is admirably adapted for applying as a stucco.

Mortar.

1.—A mortar that can hardly be picked to pieces is made as follows: Mix equal parts of lime and brown sugar with water, and be sure the lime is thoroughly air-slaked. This mortar is equal to Portland cement, and is of extraordinary strength.

2.—Mortar is composed of quicklime and sand reduced to a paste with water. The lime ought to be pure, completely free from carbonic acid, and in the state of a very fine powder; the sand should be free from clay, partly in the state of fine sand, and partly in the state of gravel; the water should be pure; and if previously saturated with lime, so much the better. The best proportions are 3 parts of fine and 4 parts of coarse sand, 1 part of quicklime, recently slaked, and as little water as possible.

3.—The addition of burnt bones improves mortar, by giving it tenacity, and rendering it less apt to crack in drying; but they ought never to exceed ¼ of the lime employed.

4.—When a little manganese is added to the mortar it acquires the important property of hardening under water, so that it may be employed in constructing those edifices which are constantly exposed to the action of water. Limestone is often combined with manganese; in that case it becomes brown by calcination.

5.—*Impenetrable.*—To make impenetrable mortar, mix thoroughly ¼ of fresh unslaked lime with ¾ of sand, and let 5 laborers make mortar of these ingredients, by pouring on water with trowels, to supply one mason, who must, when the materials are sufficiently mixed, apply it instantly as cement or plaster, and it will become as hard as stone. The lime used should be stone lime; previous to its use it should be preserved from the access of air or wet, and the plaster screened for some time from the sun and wind.

6.—*Khorassar or Turkish.*—Powdered brick and tiles, 1 part; fine sifted lime, 2 parts; mix with water to the desired consistency, put on layers of 5 or 6 in. in thickness, between the courses of brick and stone. This mortar is used where great solidity is required in buildings.

7.—*Waterproof.*—Instead of slaking in the usual manner, use a solution of copperas dissolved in warm water, and use only fine quartz sand.

Roads and Pavements.

Cement Slabs.—These are made in metal-lined molds (as described with artificial stone slabs), with or without pressure. The cement is Portland, and should not only be good, but well matured. Granite chippings are mixed with the cement about 3 to 4 parts to 1 part cement, the granite passing through a 3-16-in. mesh sieve. After well mixing in a dry state, water is applied sparingly by a fine rose, and the whole well mixed into a fairly stiff mass. The mixture is put into metal-lined molds, the corners and angles being well filled, and the whole rammed or beaten firm. When set hard, the slab is taken out and set in the open air to mature, if possible, for 3 or 4 months. They are then in good condition for paving. A better slab is produced when pressure can be used. This necessitates stiff cast-iron molds, and a simple form of machine to effect the pressure with. By this means a good slab can be made with such material as clinker, to take the place of the granite, and can be put to utilize some of the waste material from destructor furnaces. In laying these slabs, a bedding of sand or fine ash is put on the earth, and a layer of lime mortar put on this. The slab is then laid, and the joints between the slabs are grouted with thin mortar. This makes an excellent pavement.

Coke Breeze.—This is more usually adopted for covered floors or walks. The coke should pass through a sieve of ⅜-in. mesh, but not be so fine as to pass through a 1-16-in. mesh; dust should not be used. Mix together 2½ parts of coke, 2 parts clean, sharp sand, and 1 part Portland cement. Let the parts be measured, not guessed, and mixed in a dry state, then wetted sparingly with a rose. Mix into a stiff mass, and use.

Concrete.—1.—The terraza floors used in Italy at the present day are made in the following manner: First coat, a concrete consisting of common lime ¼, sand and fine gravel ¾, laid 6 in. thick, and well beaten with wooden rammers; after 2 days, in that climate, it is sufficiently dry for the next coat. Second coat, a terraza consisting of pounded brick or tile 1-6, common lime 2-6, sand 3-6, of the consistency of mortar, laid 1¼ in. thick, well beaten with a light, flat rammer. After 2 or 3 days it is hard enough for the next coat. Third coat, a similar terraza, but with the grit of broken stones, instead of sand, in it, laid on like a coat of plaster, with a trowel. After this has been laid for 1 day a layer of small, hard, broken stones is pressed into it; these stones should be of some substance that will take a polish, and be of uniform size (they are passed through a gravel screen), about that of a walnut; these being afterward rubbed to a smooth, even surface with some smooth, hard stone, form a kind of mosaic work. The stones are frequently selected by color, and laid in the third coat to a rough pattern. They should be moistened with oil or water till hard set.

2.—Dig the earth out about 8 in., fill in with coarse gravel and stones, well rammed, and leveled about 5 in. Mix Portland cement to the consistency of cream, and pour over, spreading it with a stiff broom; when hard, mix finer gravel with cement and water, and fill up to within ¾ in. of the surface; when hard, mix clean, sharp sand and Portland cement, half and half, with water to about the thickness of mortar, and finish, slightly rounding. It should not be walked on for a day or two. Cement must be Portland, and fresh.

3.—It is sometimes contended that a concrete pavement or floor should consist of 3 layers, but there can be no doubt that the material of the 2 under layers can as well be mixed and laid as one. This would then consist of the roughest and a medium material, the latter filling the voids in the larger stuff. This layer is best allowed to set before the final coat, which is made up of fine stuff. When this has been laid, and ruled or leveled off, a short time should be allowed for it to commence setting, then the following finishing-off process is done. Take a hand float and beat the surface lightly until the "fat" appears, or until it "creams," then trowel it off with light strokes, and the finished surface will be as smooth as if it was wholly cement. It is best to let the top coat get somewhat firm before the hand float is used as described, for this is done while the material is soft an uneven surface will result.

Footwalks.—An excellent cement for all uses which required exposure to the weather or dampness is described in *Der Praktische Maschinen-Constructeur.* It is made by thoroughly stirring Portland cement or good hydraulic lime into a worm solution of glue, so as to make a thick paste, and applying it immediaately. In three days it acquires extraordinary hardness and tenacity. It is an excellent cement for joining the porcelain heads to the metal spikes which are used as ornamental nails.

Granolithic.—This consists of 1 part Portland cement and 3 parts of granite chippings, red oxide being added to give the characteristic color, if desired. The whole is first mixed dry, then wetted sparingly with a fine rose, well worked into a mass, and laid on a good foundation in the usual way. When set, the surface is polished with a rubber of York gritstone, fixed in a handle with an iron shoe, water being freely used during the rubbing, the presence of the granite making the polish possible, as cement only cannot be polished. Chippings of colored marble can replace the granite, and can be polished, but have quite the good wearing qualities of granite.

Roadway Cement.—The first coat should be 3½ in. thick, 7 parts of sharp, coarse sand or fine gravel to 1 part of cement, thoroughly mixed in a box, dry, then dampened with water. Spread it on the ground in sections or squares. As soon as it is set, put on another coat, 1 in. thick, of 1 part cement to 3 parts sharp sand. When that is set, for a finishing coat put ½ in. thick of 1 part cement and 1 part sand. Do not drive over it for 5 days.

Stone Flags, Artificial.—1.—Take 1 part of fresh and good quality Portland cement and 3 parts of small granite chippings (passed through a 3-16-in. mesh sieve), these chippings having been previously washed and dried. Well mix the cement and 1 part sand. Do not drive sprinkle water on carefully, using a fine rose to prevent the cement being washed through the chippings, and when thoroughly mixed (and before setting commences) fill the molds, taking care to fill all angles and corners, that the finished flags may have good sharp angles. The molds, which are probably wooden frames, must be metal-lined, and soft soap may be used to prevent sticking. When the flags are sufficiently hard, loosen the molds and then immerse the flags in a tank (galvanized-iron tank will do) of silicate of soda solution, and allow them to remain 2 or 3 weeks. After this remove the flags and stack them carefully in the open air to season; the seasoning should be allowed considerable time. To make silicate of soda, the silicate stone is first crushed in an edge-runner mill and then put into steam-jacketed boilers with good caustic soda. Steam is then turned on, and the heat causes the two ingredients to combine, and form silicate of soda.

2.—Flag Pavement.—Solution of water glass, 20 parts; quicklime, 8 parts; whiting, 80 parts. Used for flag pavement by mixing with small, sharp-edged stones and stamping in molds. Hardens slowly.

3.—Stone Sidewalks, Artificial.—English Portland cement is generally preferred. Procure a sharp, light-colored sand, and wash it free from all particles of soft earth or soil; also some stone chips, gravel and large stone. Excavate the sidewalk about 18 in. deep, and fill in the large stone to within 6 in. of the surface; prepare a concrete made of the cement, 1 part, stone chips and gravel about 6 parts, and bed it in upon the stone bottom to within 2 in. of the surface; then prepare a concrete of the cement, 1 part, and fine sand 2 parts, and lay it in up to the surface, floating the surface with the cement at pleasure. Finish by lining off into very regular blocks. A more economical sidewalk can be made by omitting the stone bed, but it will require a good hard soil to lay it on, and then will not be so sure of being permanent.

Walks, Fravel and Tar.—Take 2 parts very dry lime rubbish and 1 part coal ashes, also very dry, and both sifted fine. In a dry place, on a pry day, mix them, and leave a hole in the middle of the heap, as bricklayers do when making mortar. Into this pour boiling hot coal tar, mix, and when as stiff as mortar put in 3 in. thick where the walk is to be; the ground should be dry, and beaten smooth; sprinkle over it coarse sand. When cold, pass a light roller over it; in a few days the walk will be solid and waterproof.

CASEIN CEMENTS

1.—Casein is used for a number of cements which are useful, and, if prepared from pure casein, are very permanent. The cements of casein with lime are particularly recommended. Pure casein is prepared in the following way: Skim the milk carefully until there is not a trace of cream. Let it stand in a warm place until it curdles. Then pour it through a paper filter. Wash the casein remaining on the filter with rain water until the water shows no trace of free acid. Tie the casein in a cloth, and boil in water to remove all fat. Spread on blotting paper, and dry in a moderately warm place. It will shrivel up in a hornlike mass.

2.—A solution of casein in a concentrated aqueous solution of borax, made with cold water, makes a very tenacious cement.

3.—Casein, in powder, 5 av.oz.; quicklime, in powder, 1av.oz.; camphor, in powder, 120 grams. Mix. This powder to be made into a cream with sufficient water before using.

4.—Casein, in powder, 2 av.oz.; borax, in powder, 1 av.oz. Mix. Made into a paste with water when required.

5.—Casein, in powder, 3 av.oz.; quicklime, in powder, ½ av.oz.; salt of tartar, in powder, ½ av.oz. Mix. Made into paste with water when required.

6.—Freshly precipitated casein, sufficient; caustic soda, ½ av.oz.; potassium bichromate, ½ av.oz.; boiling water, 4 fl.oz. Dissolve the caustic soda in the boiling water, maintain the heat for 15 minutes, adding to it all the casein it will dissolve, and allow to get cold. Rub the bichromate of potash to a powder in a Wedgwood mortar, and mix intimately with the cold casein solution. Put in a tin can with tight-fighting cover, and keep in a cool place. In using the casein cements, the edges of the articles must be perfectly clean, and the thinnest possible coating put on both surfaces and put together with as much pressure as possible, and set aside in a dry place for several days.

7.—*Foreign Casein Cements.*—a.—The chief cement used in the island of Sumatra is made from the curd of buffalo milk, prepared in the following way: The milk is left to stand till all the butter has collected at the top. The latter is then removed and the thick, sour mass left is termed the curd. This is squeezed into cakes and left to dry, by which it becomes as hard as flint. For use, some is scraped off, mixed with quicklime, and moistened with milk. It holds exceedingly well, even in a hot, damp climate, and is admirably adapted for mending porcelain vessels.

b.—In the German cantons of Switzerland a compound of cheese and slaked lime is used, under the name of *Kaseleim*, for laying floors, puttying joiners' work, making blocks for hand printing cotton and tapestry goods, and other like purposes. The material sets so rapidly that it is necessary to mix it as the work goes on, which entails trouble, and necessitates a certain knack in its use. A Swiss chemist, Brunnschweiler, of St. Gall, has invented a preparation of lime and skim milk, to which he gives the name of *Kaseleim-pulver*, whereby these inconveniences are avoided. Fill a bottle to ¼ of its height with damp casein; then fill the flask with silicate of soda (water glass), and shake frequently until the casein is dissolved.

8.—*Whey White of Egg, Lime.*—a.—Use white or an egg, beaten up, an equal quantity of water, and add enough slaked lime to make a paste; apply immediately. Whey might take the place of water, on account of the albuminoids contained.

b.—Mix rapidly white of egg with plaster of paris containing ¼ its weight of freshly slaked lime.

c.—Mix white of egg with scraped lime, or calcined plaster of paris, or calcined and sifted oyster shells.

d.—Work together freshly prepared casein and freshly calcined lime to make a thick paste.

e.—Mix equal amounts of dry, powdered casein and slaked lime and make into a paste with water. Whey or skim milk may be used in place of water.

CELLULOID

1.—Make a mixture composed of 3 parts of alcohol and 4 parts of ether; keep in a well corked bottle, and when celluloid articles are to be mended, paint the broken surfaces over with the alcohol and ether mixture until the surfaces soften; then press together and bind, and allow to dry for at least 24 hours.

2.—Dissolve 1 part of gum camphor in 4 parts of alcohol; dissolve an equal weight of shellac in such strong camphor solution. The cement is applied warm, and the parts united must not be disturbed until the cement is hard.

3.—Rasp the celluloid fine, and let it macerate in 90% alcohol to render it soluble. A solution may also be prepared (more inflammable) by mingling 5 parts of celluloid in 16 parts of a solution of amyl acetate, acetone and sulphuric ether.

4.—*Glue for Celluloid.*—Shellac, 2 parts; spirit of camphor, 3 parts; alcohol, 4 parts; dissolve in a warm place. This glue may be used for fastening celluloid to wood, tin, or other materials. It should not be exposed to the air when not in use. Apply hot.

5.—*Celluloid on Wood Leather etc.*—Make a solution of 2 parts shellac in 2 parts spirits of camphor and 6 to 8 parts of 90% alcohol.

DENTAL CEMENTS

1.—Tooth cements are extensively used in English, but their use is not advised. Consult a good dentist.

2.—*Evans' Cement.*—Take of pure grain tin, 2 parts; cadmium, 1 part; beeswax, 1 part. Melt them together in a porcelain crucible, at a heat not exceeding 600° F., and "cast" the alloy so as to form a small ingot, which, when cold, must be reduced to filings. For use, a small quantity of these "filings" is formed into an amalgam with quicksilver, the excess of the latter is squeezed out through a piece of chamois leather, and the amalgam at once applied to the tooth. The cement is recommended by Mr. Evans as very durable and unobjectionable. Its color is intermediate between that of silver and tin, but it is said not to darken so readily as the simple amalgam of those metals.

3.—*Fairthorne's Cement.* — Powdered glass, 5 parts; powdered borax, 4 parts; silicic acid (SiO_2), 8 parts; zinc oxide, 200 parts. Powder very finely, and mix; then tint with a small quantity of golden ocher or manganese. The compound, mixed, before use, with concentrated, syrupy zinc chloride solution, soon becomes as hard as marble, and constitutes a very durable tooth cement.

4.—*Gutta Percha Stopping.*—a.—This is pure, uncolored, native gutta percha. A small piece is softened in hot water and at once applied. It answers well for filling hollow teeth, with central cavities, and is efficient and durable.

b.—Soften gutta percha on a tin or porcelain slab, over boiling water. Knead in gradually zinc oxide until of a suitable consistency. Knead the mass throughly for an hour or more.

c.—Temporary Stopping.—White beeswax, 1 oz.; red gutta percha, 4 oz.; precipitated calcium ca[illegible] 4 oz. Melt the wax, add gradually the gutta percha, and afterward the calcium carbonate, kneading all together in a warm mortar.

d.—Aluminized Gutta Percha Stopping. —Aluminum filings, 5 oz.; prepared chalk, ½ oz.; zinc oxide, 1 oz.; white gutta percha, 8 oz. Mix with the aid of gentle heat.

5.—*Huebner's Cement.*—Zinc oxide, 500 parts; powdered manganese, 1.5 parts; yellow ocher, powdered, 1.5 to 4.0 parts; powdered borax, 10 parts; powdered glass, 100 parts. As grinding liquid it is well to use exclusively acid-free zinc chloride, which one may prepare oneself by dissolving pure zinc, free from iron, in concentrated, pure hydrochloric acid, in such a manner that zinc is always in excess. When no more hydrogen is evolved the zinc in excess is still left in the solution for some time. The latter is filtered, and boiled down to the consistency of syrup. Commercial zinc oxide cannot be employed without previous treatment, because it is too loose; the denser it is the better is it adapted for dental cements, and the harder the latter will be. For this reason it is well, in order to obtain a dense product, to stir the commercial pure zinc oxide into a stiff paste with water to which 2% of nitric acid has been added; the paste is dried and heated for some time at white heat in a Hessian crucible. After cooling, the zinc oxide thus obtained is very finely powdered, and kept in hermetically closing vessels, so that it can absorb no carbonic acid. The dental cement prepared with such oxide turns very hard, and solidifies with the concentrated zinc chloride solution in a few minutes. In place of the zinc-chloride cements, phosphate-zinc cements are, of late, more and more gaining ground. They all consist, essentially, of zinc oxide and the thickish liquid of meta- or pyro-phosphoric acid. Mix pyro- and meta-phosphoric acid, or dissolve in ortho-phosphoric acid, either pyro-phosphoric acid or meta-phosphoric acid or pyro-phosphoric acid anhydride; the liquid may also contain zinc oxide, dissolved, about 1-20 to 1-10.

6.—*Phosphate Cement.* — a. — Concentrate pure phosphoric acid till semi-solid; mix aluminum phosphate with it by heating. For use, mix with basic oxide of zinc, to the consistency of putty. The light oxide of zinc should not be used here, nor in making oxychlorides. The cement sets in two minutes.

b.—"By calcinning magnesium nitrate an oxide is made. This, when hydrated, forms a durable cement. When mixed with phosphoric acid it hardens at once, growing so hot as to burn the hand. As basic oxide of zinc forms with phosphoric acid a slower setting cement, the indication is plain. I have used for pulp capping and temporary filling the following mixture: Basic oxide of zinc, 2 parts; oxide of magnesium, 5 parts; grind them together. For use, mix to a paste with syrupy phosphoric acid. This sets in 30 seconds."

7.—*Poudre Metallique.*—According to Mr. Redwood, the article sold in Paris under this name is a triple amalgam of mercury, silver and ammonium, with the latter in excess.

8.—*Silica.*—A mixture of levigated porcelain, plaster of paris, and steel filings, in equal proportion, made into a paste with thick, quick-drying copal varnish. It is only adapted to fill central cavities in the double teeth, as its color unfits it for the front ones.

9.—*Sorel's Cement.*—Mix commercial zinc white with half its bulk of fine sand, adding a solution of chloride of zinc of 1.26 specific gravity, and rub the whole thoroughly togeher in a mortar. The mixture must be applied at once, as it hardens very quickly. (See also *Zinc* below.)

10.—*Taveare's.*—This is powdered mastic mixed with about half its weight of ether, and then with sufficient powdered burnt alum to form a stiff paste. It must be kept in a closely stoppered bottle It has little hardness and durability.

11.—*Vienna Cement.*—Powdered asbestos made into a paste with thick mastic varnish. Neither hard nor durable.

12.—*Wirth's Cement.*—Levigated quartz made into a paste with very thick mastic varnish. The color is good, but it is not very durable.

13.—*Zinc Amalgam; Dentist's Zinc.*—Pure zinc filings, combined with twice their weight of quicksilver, a gentle heat being employed to render the union more complete. It is best applied as soon as made. Color, gray; often proves effective and durable.

14.—*Zinc Cement, Oxychloride of.*—a.—This cement, or mastic, is prepared by mixing 1 part of the finest pulverized glass with 3 parts of oxide of zinc thoroughly calcined (made from the carbonate), which is afterward kept in well stoppered glass vials. Separately, 1 part of borax is dissolved in the smallest possible quantity of water. It is mixed with a solution of chloride of zinc of 1.5 to 1.6 sp. gr., and is kept in this state in well closed vials. To use this mastic, enough of the powder is mixed with some of the liquid to form a putty, which hardens readily until like stone. Under the name of Paris dental cement, a similar preparation is sold in the pharmacies which has even been used for filling hollow teeth. This composition can serve excellently for many other purposes; for example, to attach to each other different parts of technical, scientific or domestic appliances, where a tenacious, quickly hardening cement is required.

b.—That in most general use for ordinary plugging is composed of oxide of zinc, 5; silex, 2; borax, 1; moistened with a solution of 1 oz. zinc chloride in 6 drams of water. Where it is to be used as a capping or temporary filling over freshly exposed pulps, the fluid should be zinc chloride 1 oz., water 1 to 2 oz., making a solution of only sufficient strength to cause the mixture to set. The cavity having been cleaned, creosote should be applied to the exposed pulp, and the oxychloride introduced in a semifluid state, and protected by a rubber dam from the fluids of the mouth until properly hardened (half an hour usually suffices). It is advisable to allow several days to intervene for the more thorough solidification of the cap prior to the removal of the excess of material and final insertion of the metal stopping.

GLASS, PORCELAIN, CROCKERY, MARBLE CEMENTS

1.—Shredded Russian isinglass, cut Penang isinglass, water, absolute alcohol, acetic ether, gum mastic, gum ammoniac, sandarac, of each sufficient. Macerate in cold distilled water, not over 70° F., for 24 hours, equal parts of best shredded Russian and cut Penang isinglass. Strain off all superfluous fluid by letting the swollen gelatine remain for a few minutes on a coarse towel stretched over a colander. Dissolve at a gentle heat in the smallest possible quantity of alcohol of 50°, and strain through a cloth to remove the muscular fibers. Add to aportion of absolute alcohol 5% of its volume of acetic ether, and in this dissolve as much of the following mixture as will make a liquid of the consistency of syrup: Gum mastic, 1 part; gum ammoniac, 2 parts; sandarac, 3 parts. Mix the solution of gelatine and the solution of gums in equal parts, thoroughly incorporating the mixture. Put into small vials, and cork well. When required for use, heat in a water bath until fluid.

2.—*Carlsbad Patent Cement.*—(1) Water glass, 1.340 sp. gr. (2) Washed chalk, 1 part; kaolin, 19 parts. Mixture alternately replaced by baryta white or precipitated barium sulphate. The object to be warmed; (1) and (2) mixed to a thin paste, edges of fractured parts smeared with it, and pressed togehher; 12 hours to dry.

3.—*Casein and Soluble Glass.*—Casein, dissolved in soluble silicate of soda or potassium, makes a very strong cement for glass or porcelain.

4.—*German Cement.*—An excellent cement for glass or earthenware is made as follows: Gum shellac, 2 parts; Venice turpentine, 1 part; fuse together in an iron pot, and when partially cool form into sticks. When wanted for use, melt near a gentle heat. Care must be taken while fusing the materials to keep the vessel closed, as the turpentine is very inflammable. Or: Litharge, 2 parts; unslaked lime and flint glass, of each 1 part; pulverize separately, and mix. To use it, wet with old drying oil.

5.—*London Cement.*—The London cement for joining broken glass, china, wood, etc., is made by taking a piece of Gloucester cheese, boiling it 3 times in water, etc., is made by taking a pice of evaporate, and mixing the paste thus left with dry quicklime.

6.—*Mucilage, to Unite Glass, Wood or Porcelain.*—a.—Strong gum arabic solution, 8 1-3 oz., to which a solution of 30 gr. sulphate of aluminum, dissolved in 2-3 oz. of water, is added.

b.—Put 1 or 2 drops of glycerine in a small bottle of mucilage. This will prevent the gum cracking or drying. Too much glycerine must not be added, as that would prevent the gum from hardening.

7.—*Riveting Porcelain and Glass.*—According to the *Metallarbeiter*, porcelain (and glass) can be quite readily pierced with steel tools. Hardened drills of ordinary shape, moistened with oil of turpentine, if the glaze or vitreour body is to be pierced, are best for this purpose. In the case of majolica, and glass without enamel, the drilling should be done under water. The vessel should be filled with water, and placed in a receptacle containing water, so that the drill is used under water, and after piercing the clay body, reaches the water again. In the case of objects glazed on the inside, instead of filling them with water, the spot where the drill must come through may be underlaid with cork. The pressure with which the drill is worked is determined by the hardness of the material; but when the tool is about to reach the other side it should gradually decrease, and finally cease almost altogether, so as to avoid chipping. In order to enlarge small-bore holes already existing, three-cornered or four-square broaches, ground and polished, are best adapted.

8.—*Stick Cement.*—a.—Melt together, sulphur, 6 parts; white Burgundy pitch, 4 parts; shellac, 1 part; elemi, 2 parts; mastic, 2 parts; powdered kaolin, passed through a very fine sieve, 6 parts. Before applying, the surfaces to be joined must be carefully heated.

b.—Best and purest gum arabic is put into a small quantity of water, and left till next day, when it is of the consistency of treacle. Calomel (mercurous chloride or subchloride of mercury, poison) is then added to make a sticky mass, and well mixed on a glass plate with a spatula. No more is to be made than that required for immediate use. The cement hardens in a few hours, but it is better to leave it for a day or two.

c.—The *Pharmacist* recommends the following as a proved recipe: "Take 1 oz. of Russian isinglass, cut it in small pieces, and bruise well, in order to separate the fibers; then add 6 oz. of warm water, and leave it in a warm place that the isinglass may dissolve, which will required from 34 to 48 hours. Evaporate this to about 3 oz. Next dissolve ½ oz. of mastic in 4 oz. of alcohol, and when this is ready transfer the isinglass from the evaporating dish to a tin can (an empty ether can will be found convenient), heat both solutions, and add the mastic solution to the isinglass in small quantities at a time, shaking the can violently after each addition. While still hot strain the liquid through muslin cloth and put up in ½-oz. bottles. This cement is very valuable, and articles such as mortars, graduates, etc., mended with it, have been in use for years; and, in fact, seem to be stronger than they were originally.

d.—Pure casein (see *Casein*) is dissolved in sodium silicate (water glass) in the proportion of 1 part of casein to 6 or 7 of the silicate. Apply at once, and dry in the air.

e.—Use bleached shellac and turpentine, varying proportions.

f.—Elemi, 1 part; shellac, 4 parts; turpentine, 2 parts. Melt.

g.—Use Canada balsam, which can be obtained at any artists' colorman. This is used by opticians to cement their lenses together, and is perfectly transparent.

9.—*Transparent Cement.*—a.—Dissolve 1 part of India rubber in 64 parts of chloroform; then add gum mastic, in powder, 14 to 24 parts, and digest for 2 days, with frequent shaking. Apply with a camel's-hair brush. For glass.

b.—According to *Dingler's Polytechn. Journal*, a very strong, transparent cement, applicable to wood, porcelain, glass, stone, etc., may be made by rubbing together in a mortar 2 parts of calcium nitrate, 25 parts of water, and 20 parts of powdered gum arabic. The surfaces to be united are to be painted with the cement, and bound together until completely dry.

c.—Pure, unvulcanized rubber, 75 parts; dissolve in 60 parts of chloroform, and 15 parts of mastic are added.

10.—*Water Glass Cement.*—Solution of water glass, 48 parts; elutriated glass powder, 8 parts; elutriated powder of fluorspar, 16 parts. Stir together quickly. The paste which is formed should be applied at once. This cement hardens in a few days, so that the article can be heated with safety.

Crockery Ware.

1.—One of the strongest cements, and easiest applied for this purpose, is lime and the white of an egg. To use it, take a sufficient quantity of the egg to mend one article at a time, shave off a quantity of lime, and mix thoroughly. Apply quickly to the edges, and place firmly together, when it will very soon become set and strong. Mix but a small quantity at one time, as it hardens very soon, so that it cannot be used. Calcined plaster of paris would answer the same purpose as lime.

2.—Isinglass, 1 part, steeped in 4 parts of water, and dissolved in 4 parts of glacial acetic acid.

3.—*Botany Bay.*—Yellow gum and brick dust, equal parts, melted together. Used to cement coarse earthenware, etc.

Glass, Cements for.

1.—Five parts of pumice-stone are mixed with 1 of turpentine and 2 of shellac.

2.—India rubber, 10 parts; chloroform, 6 parts; mastic, 2 parts. This size is also good for making glass adhere to other hard surfaces.

3.—Delicate glassware, such as Venetian glass, can be cemented with best fish glue, applied hot and afterward tied well.

4.—Ten parts of gelatine are mixed with 2 parts of acid chromate of lime, in solution. This cement is hardened by the action of light.

5.—Lead, 3 parts; tin, 2 parts; bismuth, 2½ parts. A good cement for glass, and one which completely resists the solvent action of water, may, according to Herr H. Schwartz, be prepared by the following process: From 5 to 10 parts of pure, dry gelatine are dissolved in 100 parts of water. To the solution about 10% of a concentrated solution of bichromate of potash is added, and the liquid is kept in the dark. When articles joined by this cement are exposed to the light the gelatine film is acted upon by the chemical rays, the chromate being partially reduced, and the film of cement becomes tough and durable.

6.—Fuse together equal weights of rosin, yellow wax and Venetian red.

7.—Soak isinglass in water, and dissolve the swollen mass in glacial acetic acid.

8.—Fuse together: Rosin, 8 lb.; plaster of paris, 2 lb.

9.—Fuse together: Rosin, 10 lb.; shellac, 2 lb.; rouge, 1 lb.

10.—Best gelatine, 100 parts, dissolved by warming in 150 parts of 90% acetic acid; then add 5 parts of ammonium bichromate in fine powder. Keep away from light. When drying mended parts, expose directly to the sun.

11.—Finely pulverized caustic lime, 10 parts, triturate with 25 grams of fresh egg albumen, add 10 parts of water, then mix with 55 parts of plaster of paris, and apply at once.

12.—Take ⅛ oz. of white glue and dissolve in the smallest quantity of water possible; then add 2 oz. proof spirits, and dissolve in it 10 gr. gum ammoniac and 30 gr. of gum mastic. Mix carefully with the glue solution, and when wanted for use immerse in hot water until in a liquid condition. Apply to the edges of the broken material, and unite carefully. This will bear an ordinary degree of warmth, but not likely to stand boiling water.

13.—*Dextrine Paste.*—Yellow dextrine, 8 oz.; thymol, 10 gr.; tepid water, 18 fl.oz. Dissolve.

14.—*Lime-Oil Cement.*—Quicklime, 4 parts; litharge, 6 parts; linseed-oil varnish, 1 part.

15.—*Oil Cement.*—a.—Burned lime, 10 parts; litharge, 15 parts; pipeclay, 5 parts; linseed-oil varnish, 3 parts.

b.—Without Heat.—Boil isinglass in water to a creamy consistency, and add a little alcohol. Warm before using.

c.—Melt 5 or 6 bits of gum mastic, as large as peas, in the smallest quantity of alcohol; mix with 2 oz. of solution of isinglass (made by dissolving isinglass in boiling brandy to saturation), having previously mixed the isinglass solution with 2 or 3 bits of galbanum, or gum ammoniac; keep in a well corked bottle, and gently heat before using.

d.—With a small camel's-hair brush rub the edges with a little carriage oil varnish, and, if neatly put together, the fracture will hardly be perceptible; and, when thoroughly dry, will stand both fire and water.

e.—Dissolve fine glue in strong acetic acid to form a thin paste.

f.—Canada balsam, or clear glue (gelatine), to which has been added a small quantity of bichromate of potash. The latter soon loses its yellow tint, and becomes unaffected by damp when exposed to daylight.

g.—Two parts of common black pitch and 1 part of gutta percha, melted, and worked together till mixed; or 2 parts shellac, 1 part Venice turpentine, melted together. These would want using warm. They are both impervious to weather influences.

Porcelain and China.

1.—Gum ammoniacum, 3 dr.; Brazilian isinglass, 3 oz.; distilled water, 6 oz.; methylated spirit, 12 oz. Add 4 oz. of alcohol to the water, in which dissolve the isinglass by the aid of gentle heat; dissolve the gum in the remainder of the alcohol and add to the previous solution.

2.—Fresh casein, 100 parts; triturate well with sufficient soluble glass to make a mass of the consistency of honey.

3.—Add plaster of paris to a strong solution of alum until the mixture is of the consistency of cream. It sets readily, and is said to unite glass, metal, porcelain, etc., quite firmly. It is probably suited for cases in which large rather than small surfaces are to be united.

4.—Use thick white lead paint.

5.—Milk is coagulated with acetic acid, and the casein thus formed is washed well in water and then dissolved in a cold saturated solution of borax; a clear solution is thus obtained which is superior to gum arabic. For porcelain, mix with finely powdered quicklime, apply to the ware immediately, bind with cord, and expose to gentle heat.

6.—Into a clear solution of gum arabic stir plaster of paris; use immediately; water will destroy the joint made by this cement.

7.—Melt together 75 gr. of fish glue and 5 drams of glacial acetic acid; afterward heat the solution until it becomes of a syrupy consistency, so as to form a jelly upon cooling. To use it, the jelly is placed upon a stove, in order to bring it to a liquid state, after which the edges of the broken crockery are coated with it, and the pieces strongly compressed.

8.—Gelatine, 2 oz.; water, 4 oz.; when the gelatine has fully swelled add 2 oz. of glacial acetic acid.

9.—Russian glue, 8 oz.; wated 4 oz. Macerate for 4 hours, then dissolve in water bath, and add 6 oz. of strong acetic acid.

10.—An almost invisible joint may be made, with careful handling, with the following: Chloroform, 60 parts; India ruber, 25 parts; mastic, 15 parts. Cut the ruber into shreds, put into a suitable vial, and pour on the chloroform. Stopper tightly and set aside until the rubber is disolved; then add the mastic, and let stand until the same is dissolved. Apply the cement to each surface to be united, and let the pieces stand until the greater part of the chloroform is evaporated; then unite, press firmly to place, and, if possible, tie in position. When the cement is apparently thoroughly dry on the surface scrape off the superfluity, and dust over the line of junction a little zinc oxide, chalk, powdered infusorial earth, or some such material, and with a clean pencil brush it over the joint. After the cement has become perfectly dry remove the cords and rub off the superfluous powder. The joint can scarcely be discovered if the work has been well done.

11.—*Cheese Cement.*—Take skim-milk cheese, cut it in slices, and boil it in water. Wash it in cold water, and knead it in warm water several times. Place it, warm, on a levigating stone, and knead it with quicklime. It will join marble, stone, or earthenware so that the joining is scarcely to be discovered.

12.—*Sulphur Cement.*—Sulphur, 7 parts; white pitch, 5 parts; shellac (bleached), 1 part; mastic, 2 parts; gum elemi, 2 parts; glass meal, 7 parts.

Special Purposes.

1.—*Cap Cements.*—These are so named because they are used to fix on parts of electrical or other apparatus to glass. They are very useful for many purposes, and should find a place in every laboratory and amateur's workshop. (See also *Faraday's Cement.*) a.—Glue best white, 11 oz.; white curd soap, 1 oz.; plaster of paris, 3¼ lb.; water, ½ gal. The glue is put to soap overnight in just enough of the water to well cover it. In the morning (or when properly softened) it is dissolved, together with the soap, in the rest of the water, previously heated to boiling. When a quantity of the cement is required, a sufficient quantity of the plaster of paris is mixed up quickly with enough of the warm liquid to form a smooth thin paste. This paste must be used at once, as it soon sets or hardens. When hardened it is impervious to coal oil.

b.—(C. G. Williams.) Equal weights of red lead and white lead used for chemical and electrical purposes. For cementing glass tubes, necks of balloons, etc., into metal mountings. This is preferable to white lead alone, and may be depended on for temperature up to 212°.

c.—Rosin, 5 lb.; beeswax and dried Venetian red, of each 1 lb.; melted together.

d.—Black rosin, 7 lb.; red ocher, ½ lb.; plaster of paris, ½ lb., well dried, and added while warm; heat the mass to a little above 212° F. (100° C.) and agitate it together till all frothing ceases, and the liquid runs smooth; the vessel is then removed from the fire, and the contents are stirred till sufficiently cool for use.

e.—Linseed oil, 4 oz., added to the ingredients of the last.

2.—*Chemical Cement.*—a.—A good cement for chemical and electrical apparatus may be prepared by mixing 5 lb. of rosin, 1 lb. of wax, 1 lb. of red ocher and 2 oz. of plaster of paris, and melting the whole with moderate heat.

b.—Yellow wax, 4 parts; common turpentine, 2 parts; Venetian red (well dried), 1 part; melted together. Use as a temporary stopping or lute for the ends or joints of tubes which are not exposed to much heat, as in alkalimetry.

c.—Mix equal parts of wheat flour, finely powdered Venetian glass, pulverized chalk, and a small quantity of brick dust, finely ground; these ingredients, with a little scraped lint, are to be mixed and ground up with the white of eggs. It must then be spread on pieces of fine linen cloth, and applied to the crack of the glasses, and allowed to get thoroughly dry before the glasses are put to the fire.

d.—Equal parts of pitch, rosin and plaster of paris, thoroughly dried; mix together. Used for the masonry of chlorine chambers, vitriol works, etc., and as a lining for casks intended to hold chloride of lime.

3.—*Enamel and Porcelain Letters to Glass.*—a.—Copal varnish, 15 parts; drying oil, 5 parts; turpentine, 2 parts; liquefied marine glue, 5 parts; melt in a water bath, and add slaked lime, 10 parts.

b.—Rosin, 22 parts; burnt umber, 4 parts; calcined plaster, 2 parts; boiled oil, 1 part.

c.—The *National Druggist* says, replying to a correspondent who complains that porcelain letters are difficult to keep fastened to glass, that the failure of some cements to hold is due to the difference in the rate of expansion of the glass and porcelain, and recommends a cement that is likely to overcome the difficulty, as follows: Slake 15 parts of fresh quicklime in 20 parts of water; melt 50 parts of cautchouc and 50 parts of linseed-oil varnish together, and bring the mixture to a boil. While boiling pour the liquid on the slaked lime, little by little, under constant stirring. Press the mixture, while still hot, though muslin, to remove any possible lumps, and let cool. It takes this cement 2 days to set completely, but when dry it makes a joint that will resist a great deal of pulling, whether from expansion or contraction, or force acting directly (as a wedge) to pull apart the pieces united with it. By thinning the mixture down with oil of turpentine a brilliant, powerfully adhesive varnish is obtained.

d.—Eight parts of starch are mixed with 10 parts of finely powdered chalk, by using equal parts of alcohol and water, with the addition of 3 parts of Venice turpentine.

e.—Solution sodium silicate, 30 parts; slaked lime, 45 parts; mix, and add litharge, 30 parts; glycerine, q. s.; make a paste, and use immediately.

f.—Glass Labels to Bottles.—Rosin, 1 part; yellow wax, 2 parts; melt together.

4.—*Glazier's Solvent.*—a.—Dissolve soft soap in 3 times its weight of strong lye.

b.—Make a thin paste or cream with freshly slaked lime and twice its weight of pearlash and a little water.

5.—*Grinder's Cement.*—a.—Pitch, 5 parts; wood ashes and hard tallow, of each 1 part; melted together.

b.—Black rosin, 4 lb.; beeswax, 1 lb.; melt, and add of whitting, previously heated red hot, and still warm, 1 lb.

c.—Shellac, melted, and applied to the pieces slightly heated. Used to fix pieces of glass while grinding. The last is used for lenses and fine work.

6.—*Lenses.*—a.—In those of foreign make an arborescent appearance is occasionally to be seen between the elementary parts of which the lens in composed. This arises from the drying or shrinking of the balsam with which it is cemented. To remedy this unset the lens, place it in warm water, which may be still further heated till the balsam softens, separate the components, the clean with ether, benzole or turpentine. Next place a drop of pure balsam on the center of the concave surface and gently press the convex one down upon it until the balsam spreads and oozes out at the edges. Then apply a gentle heat until the balsam is found to have been hardened.

b.—C. Fleck (*Photograph. Chron.*) gives the following formula for a cement for setting objectives and other lenses *in situ*: Balata gum, 1 part; mastic, 1 part; white shellac, 1 part; benzol, 75 parts; chloroform, 75 parts; mix.

7.—Marble.—a.—Gum arabic, 1 lb.; powdered plaster of paris, 1½ lb.; sifted quicklime, 5 oz. Mix the gum with 4 oz. of hot water into a thick mucilage, add to it the powdered plaster of paris and the quicklime, adding several ounces more of water. Heat the part of marble to be mended and press tight. Excellent for mending marble slabs, etc.

b.—Marble table tops, tops of commodes, etc., that become loose, may be firmly fixed, says the *Werkstatt*, by a cement of carpenter's glue and plaster of paris, which is durable and strong. The glue is soaked in cold water until it absorbs all it can, the surplus water is drained off, then it is put on the fire and melted. When entirely dissolved, burnt sypsum is sifted in until it forms a thin paste with the glue. Stir vigorously, and apply this paste quickly to the wood and the marble, adapt the later to place, and let stand. The mixture hardens very quickly, hence it is necessary to be expeditious in making the application. Apply pressure to the slab if it is not already heavy enough to fit snugly. Let dry for 2 days.

c.—Enamel Shields to Marble Slabs.—(1) Two parts of finely crushed quartz and 1 part of finely ground heavy spar, or 3 parts of finely ground glass and 2 parts of finely crushed fluorspar, are mixed with silicate of soda to a thick paste, and used at once. If in place of the soda water glass, potash water glass is used, the cement will harden much more rapidly.

(2) The following solutions are prepared warm, best of all in the water bath: (a) Steeped isinglass, 2 parts; 96% alcohol, 8 parts; (b) mastic, 2 parts; chloride of ammonia, 1 part; 96% alcohol, 12 parts. Both solutions are thoroughly mixed while warm. When used, the cement and the article to be cemented must be heated; the cement is applied in a thin layer.

(3) A well-known solution of gutta percha in chloroform, known as traumaticine, mixed with concentrated water-glass solution, is used for cementing.

8.—*Meerschaum, Cement for.*—a.—Take some garlic, and crush it, in order to form a kind of dough; rub over the broken pieces of meerschaum with it, and reunite them by pressing very closely; bind them with iron wire, according to the strength of the pieces, and finally boil them for half an hour in a sufficient quantity of milk. Casein and quicklime cements apply here.

b.—Dissolve casein in a solution of water glass (silicate of soda) and stir into it calcined magnesia, and use at once. Casein is prepared by allowing perfectly skimmed milk to stand until it curdles, when the casein is filtered out and washed on the filter. To simplify above a little fresh cheese may be boiled in water and mixed with slaked lime and ashes, using 10 parts cheese, 20 parts water, 2½ parts lime, and 2 parts wood ashes.

9.—*Wash Basins, Cement for.*—Glass meal, 2 parts; litharge, elutriated, 2 parts; linseed-oil varnish, 1 part. Wet the powders slightly with the oil, heat and gradually add the rest. Do not use the basin for 4 days. Glass meal can be made by heating glass and throwing in cold water. Grind and elutriate.

JEWELERS' CEMENT

1.—*Amber.*—a.—Melt mastic in linseed oil. Use hot.

b.—Moisten the surfaces with solution of potash and press them together.

c.—Smear with boiled linseed oil, press strongly together and heat over a clear charcoal fire. To keep the parts in firm contact, it may be well to bind them together with fine, soft iron wire. The surfaces should be carefully cleansed before applying the cement, and as the solvent is very volatile, arrangements should be made beforehand for applying compression so that no time be lost.

d.—A solution of hard copal in ether has been suggested.

2.—*Amber, Meerschaum and Ivory.*—Soften 8 parts of isinglass in water containing a little alcohol. Add to it 1 part of galbanum, 1 part of gum ammoniac and 4 parts of alcohol. The mixture is used hot.

3.—*Armenian.*—a.—Employed by Oriental jewelers. Dissolve 10 parts of gum mastic in 60 parts of absolute alcohol, dissolve separately 20 parts of fish glue in 100 parts of water on the water bath with gentle fire and add 10 parts of alcohol of 50°. Then dissolve 5 parts of ammoniacal gum in 25 parts of alcohol of

50°. Mix the first solution with the second, stir well until assured of complete mingling, then add the ammoniacal gum and stir again. Finally put the whole on the water bath under moderate heat, in order to bring down the preparation by evaporation to 175 parts only.

b.—Dissolve 5 or 6 bits of gum mastic the size of a large pea in as much spirits of wine as will suffice to render it liquid; in a separate vessel dissolve as much isinglass (previously softened in water, though none of the water must be used) in rum, or other spirit, as will make a 2-oz. phial of very strong glue, adding 2 small pieces of gum ammoniacum, which must be rubbed or ground till they are dissolved; then mix the whole with a sufficient heat. Keep it in a phial closely stopped, and when it is to be used set the phial in boiling water. The preceding is also effectual in uniting almost all substances even glass, to polished steel.

c.—Thick isinglass glue, 1 part; thick mastic varnish, 1 part. Melt the glue, mix and keep well corked. Heat in hot water to use.

d.—Isinglass soaked in water and dissolved in spirit, 2 oz. (thick); dissolve in this 10 gr. of very pale gum ammoniac (in tears) by rubbing them together; then add 6 large tears of gum mastic, dissolved in the least possible quantity of alcohol.

e.—Isinglass dissolved in proof spirit (as above), 3 oz.; bottoms of mastic varnish (thick, but clear), 1½ oz.; mix well.

f.—*Keller's Armenian Cement.*—Soak isinglass, ½ oz., in 4 oz. water for 24 hours; evaporate in a water bath to 2 oz.; add 2 oz. alcohol and strain through linen; mix this while warm with a solution formed by dissolving ¼ oz. best mastic in 2 oz. alcohol; add of powdered gum ammoniac 1 dr. and triturate together until perfectly incorporated, avoiding as much as possible the loss of spirit by evaporation.

4.—***Horn and Bone.***—Dissolve in 6 parts linseed oil, 5 parts of mastic and 2 parts of turpentine.

5.—***Horn and Shell.***—Dissolve 500 parts of glue on the water bath with 125 parts of alcohol; add 10 parts of pulverized alum and mingle the whole on the fire. If the cement is too thick water is to be added.

6.—***Ivory.***—a.—Dissolve 1 part of isinglass and 2 parts of white glue in 30 parts of water; strain and evaporate to 6 parts. Add 1-30 part of gum mastic, dissolved in ½ part of alcohol; add 1 part of zinc white. When required for use, warm and shake up.

b.—Moisten thoroughly a small quantity of very finely powdered quicklime with white of egg to form a paste. Use at once, clamp parts firmly together and leave for 24 hours. Use as little cement as possible.

c.—To cement ivory pieces together mix 1 part albumen with 1 part glue water. Or

d.—Mix 1 part albumen with 3 parts of water or 3 parts of burnt gypsum to a thin paste.

e.—To cement small pieces of ivory to other substances melt 1 part wax, 1 part rosin and 1 part turpentine together and with the melted mass mix 1 part mountain flax. Or

f.—Melt together 2 parts gutta percha and 2 parts of ordinary pitch. Warm the parts to be cemented. Apply the cement and press the parts together.

g.—Dissolve 5 parts isinglass and 4 parts finest gilder's glue in 30 parts of water, warmed. Evaporate the mixture to ½ its volume and add 1-3 part mastic, dissolved in 1 part alcohol, and mix in, while stirring, 1 part zinc white. The cement is applied warm to the warmed parts; it dries very quickly and soon becomes hard, but can be kept for a long time in a closed receptacle.

h.—Boil isinglass in water until very thick, add enough zinc white to make the whole the consistency of molasses.

7.—*Jet.*—Shellac is the only cement used by jewelers for jet. The broken edges should be made warm before applying the shellac. Should the joint be in sight, by smoking the shellac before applying it, it will be rendered the same color as the jet itself.

8.—***Mother of Pearl.***—Isinglass in thin sheets, 4 dr.; mastic, 2 dr.; amm. chlorride, powdered, 1 dr.; alcohol, 3½ oz.; water, 4 oz. Steep the isinglass in the water for 1 day and then dissolve by aid of a gentle heat, add 16 dr. of alcohol, pass through a cloth strainer, and to the hot solution add, with constant stirring, the mastic, previously dissolved in 12 dr. of alcohol.

9.—*Seal Engravers'.*—Common rosin and brick dust melted together. Use. To fix the pieces of metal while cutting, and also to secure seals and tools in their handles. It grows harder and improves every time it is melted.

10.—***Temporary.***—A temporary cement, to fix optical glasses, stones, jewelry, etc., on stocks or handles for the purpose of painting, repairing or ornamenting is made by melting together at a good heat rosin, 2 oz.; wax, 1 dr., and whitening, 2 oz.; with this applied to the article when heated secure fixation may be obtained, unfixed at pleasure by the same means, viz., heat.

11.—*Tortoise Shell.*—a.—Dissolve in 125 parts 90% alcohol, shellac, 30 parts; mastic, 10 parts, and turpentine, 2 parts.

b.—Mastic, 15 parts; shellac, 45 parts; turpentine, 3 parts; spirit of wine, 90%, 175 parts.

c.—Gum mastic, 10 parts; shellac, 30 parts; turpentine, 2 parts; spirits of wine, 90%, 120 parts.

d.—Fit the broken pieces carefully and wrap in a piece of paper to hold them firmly in place. Heat 2 pieces of iron and place the article with the paper around it between them. The iron must not be so hot as to burn. Squeeze the article between the iron pieces for a few minutes and allow it to cool. The shell melts and forms a cement which firmly joins the broken parts.

12.—*Turkish.*—a.—Isinglass, 3 oz.; best gum arabic, 1½ oz. Put in a bottle, cover with alcohol, crok loosely. Put the bottle in water and boil until a thorough solution is made. Strain. A good cement.

b.—Isinglass, 50 parts; mastic varnish, 25 parts. Dissolve the isinglass in as little water as possible, adding some strong spirit of wine. The mastic varnish is made by pouring rectified spirit of wine and benzine over finely powdered mastic. Use as small a quantity of the solvent as possible in dissolving this. Pour the solutions together and mix thoroughly.

LEATHER CEMENTS

1.—A good cement is gutta percha dissolved in bisulphide of carbon until it is of the thickness of molasses; the parts to be cemented must first be well thinned down, then pour a small quantity of the cement on the parts to be cemented, spreading it well so as to fill the pores of the leather; warm the parts over a source of heat for about ½ minute, apply them quickly together and press hard. The bottle containing the cement should be tightly corked and kept in a cool place.

2.—This is made by mixing 10 parts of bisulphide of carbon with 1 part of oil of turpentine and then adding enough gutta percha, cut into small pieces, to make a tough, thickly flowing liquid. One essential prerequisite to a thorough union of the parts consists in freedom of the surfaces to be joined from grease. This may be insured by laying a cloth upon the part to be joined and applying a hot iron for a time. The cement is then applied to both pieces, the surfaces brought in contact and pressure applied till the joint is dry.

3.—This glue, though rather complex in composition, gives good results. Eight oz. of rye whisky are diluted with 8 oz. of water and the mixture is made into a paste with 2 oz. of starch, ¾ of an oz. of good glue are dissolved in the same amount of water, an equal amount of turpentine is added and the mixture and the paste are combined.

4.—Strong glue, 50 parts; water, sufficient quantity; turpentine, 2 parts; starch paste, 100 parts. Dissolve the glue over the fire in the water; add the turpentine, stir up well and mix with the starch paste while hot.

5.—Amalgamate by heat gutta percha, 100 oz.; Venice turpentine, 80 oz.; shellac, 8 oz.; India rubber, 2 oz.; liquid storax, 10 oz.

6.—Gutta percha, 1 lb.; India rubber, 4 oz.; pitch, 2 oz.; shellac, 1 oz.; linseed oil, 2 oz., melted together; it hardens by keeping and needs remelting for use.

7.—Best glue, 2 lb.; water, 3 pt. Dissolve by the aid of heat and when the solution has become thick add Venice turpentine, 3¼ oz.; liquefied carbolic acid, 80 min. On cooling this cement congeals to a gelatinous mass, which is then to be cut in strips and spread upon tin plates to dry. For use the cement is melted with the addition of a little vinegar and applied to the freshly cut leather and the points presed between warm iron plates for 15 minutes.

8.—Gutta percha, 100 parts; black pitch or asphaltum, 100 parts; oil of turpentine, 15 parts. Mix. It is used hot.

9.—*Belting.*—Take of common glue and American isinglass, equal parts; place them in a boiler and add water sufficient to just cover the whole. Let it soak 10 hours, then bring the whole to a boiling heat, and add pure tannin until the whole becomes ropy or appears like the white of eggs. Apply it warm. Buff the grain off the leather where it is to be cemented, rub the joint surfaces solidly together, let it dry a few hours and it is ready for practical use, and if properly put together it will not need riveting, as the cement is nearly of the same nature as the leather itself.

10.—*Gutta Percha to Leather.*—Gutta percha, 100 parts; Venice turpentine, 80 parts; shellac, 8 parts; pure unvulcanized rubber, 2 parts; liquid storax, 10 parts. Heat the turpentine, then add the gutta percha and shellac. Heat over a water bath.

11.—*Joining Leather Straps.*—Gilder's

glue, 250 parts; isinglass, 60 parts; gum arabic, 60 parts; comminuted and boiled in water until a solution of uniform consistency is obtained, then add Venice turpentine, 5 parts; oil of turpentine, 6 parts; alcohol, 10 parts.

12.—*Leather on Top Rollers.*—Gum arabic, 5½ oz; isinglass, 5½ oz. Dissolve separately in water and mix.

13.—*Leather to Pasteboard.*—Strong glue, 50 parts, is dissolved with a little turpentine in a sufficiency of water over a gentle fire; to the mixture is added a thick paste made with 100 parts of starch. It is applied cold and dries rapidly.

14.—*Saddle Paste.*—Ceresine, natural yellow, 1.5 k.: yellow beeswax, 1.5 k.; Japan wax, 1.5 k. Melt on the water bath and when half cooled stir in 8 k. of turpentine oil.

15.—*Shoemakers' Cement.* — a. — Dissolve gutta percha in chloroform to the consistency of honey. Heat the surfaces to which it is to be applied and press together.

b.—An elastic cement for patching shoes (invisible patches), attaching soles that have become "started," etc. Dissolve 10 parts of gutta percha in 100 parts of benzol, pour the solution into 100 parts of linseed oil varnish and stir until a homogeneous mixture is obtained. To make a firm and nicely appearing job the patch should be chamfered down at the edges with a keen knife and the shoe leather trimmed away around the break so as to present a clean, fresh surface to the cement.

c.—Cement for sticking on leather patches and for attaching rubber soles to boots and shoes is prepared from virgin or native India rubber by cutting it into small pieces or else shredding it up; a bottle is filled with this to about one-tenth of its capacity, benzine is then poured on till about 3 parts full, but be certain that the benzine is free from oil. It is then kept till thoroughly dissolved and of a thick consistency. If it turns out too thick or thin suitable quantities must be added of either material to make as required.

d.—The pieces of waste gutta percha, first prepared by soaking in boiling water till soft. Cut into small pieces and place in a vessel and cover with coal-tar oil. Tightly cork to prevent evaporation and allow to stand for 24 hours. Melt by standing in hot water till perfectly fluid, and stir well. Before using it must be warmed as before, by standing in hot water.

MECHANIC'S CEMENTS

Chuck Cement To Remove.—To remove chuck cement from lathe work warm the object over a spirit lamp and tap lightly with a stiff brush; the wax will adhere to the latter. If in a hurry, a few seconds' boiling in alcohol will remove the remainder of the wax.

Turner's Cement.—1.—Rosin, ½ oz.; pitch, ½ oz.; beeswax, 1 oz.; melted together, sufficient fine brick dust added to produce desired consistency.

2.—Rosin, 2 lb.; Burgundy pitch, 2 lb.; dried whiting, 2 lb.; yellow wax, 2 oz.; melted and mixed together.

3.—Black rosin, ½ lb.; yellow wax, 1 oz.; melted together and poured into a tin canister.

4.—Use a mixture of rosin, turpentine and yellow wax, then add a little pulverized sealing wax.

5.—Melt 1 lb. of rosin in a pan over the fire, and, when melted, add ¼ lb. of pitch. While these are boiling add brick dust until, by dropping a little on a cold stone, you think it hard enough. In winter it may be necessary to add a little tallow. By means of this cement a piece of wood may be fastened to the chuck, which will hold when cool; and when the work is finished it may be removed by a smart stroke with the tool. Any traces of the cement may be removed from the work by means of benzine.

6.—When wanted for use, chip off as much as will cover the chuck to the 1-16 of an inch, spread it over the surface in small pieces, mixing it with ⅛ of its bulk of gutta percha in thin slices; then heat an iron to a dull red heat and hold it over the chuck till the mixture and gutta percha are melted and liquid; stir the cement until it is homogeneous; chuck the work, lay on a weight to enforce contact, leave it at rest 20 minutes.

7.—The following is a verry excellent cement for the use of turners and artisans in general: Sixteen parts of whiting are to be finely powdered and heated to redness, to drive off all the water; when cold, this is mixed with 16 parts of black rosin and 1 part of beeswax, the latter having been previously melted together, and the whole stirred till of uniform consistency.

METALS

1.—Melt over a water bath copal varnish, 30 parts; drying oil, 10 parts; turpentine, 6 parts; when melted add 20 parts slaked lime.

2.—Boiled linseed oil, 6 parts; copal,

6 parts; litharge, 2 parts; powdered white lead, 1 part.

3.—Slaked lime, 1 part; brick dust, 2 parts; boiled linseed oil, 3 parts. Make a thoroughly homogeneous mixture of the ingredients.

4.—Glycerine and litharge, stirred to a paste, harden rapidly and make a tolerable cement for iron upon iron, for two stone surfaces and especially for fastening iron in stone. This cement is insoluble and is not acted upon by strong acids.

Brass Joints.

Caoutchouc, 2 parts; gutta percha, 1 part; brass filings, 10 parts. Melt by the aid of heat.

Brass to Tin.

To 20 parts of fine, reduced copper add sufficient sulphuric acid to make a stiff paste. To this add 70 parts of metallic mercury and work in, at the same time applying heat until the mass assumes a wax-like consistency. Warm or heat the plates to be united to about the same temperature, apply the mixture, hot, to each, then press together and let cool.

Casein Cement.

Mix washed quartz sand, 20 parts; casein, 16 parts; slaked lime, 20 parts.

Copper to Sandstone.

Take white lead, 30 parts; litharge, 3 parts; bole, 3 parts, and broken glass, 3 parts, and rub up with 2 parts linseed-oil varnish.

Coppersmiths' Cement.

Powdered quicklime mixed with bullock's blood; use at once.

Iron.

1.—Graphite, 50 lb.; whiting, 15 lb.; litharge, 15 lb. Make to a paste with boiled oil.

2.—Make a putty of white lead and asbestos.

3.—Make a paste of litharge and glycerine. Red lead may be added. This also does for stone.

4.—Make iron filings to a paste with water glass.

5.—Sal ammoniac, 4 oz.; sulphur, 2 oz.; iron filings, 32 oz. Make as much as is to be used at once to a paste with a little water. This remark applies to both the following dry recipes:

6.—Mix iron filings, 180 oz.; lime, 45 oz.; salt, 8 oz.

7.—Mix iron filings, 140 oz.; hydraulic lime, 20 oz.; sand, 25 oz.; sal ammoniac, 3 oz.

Either of these last two mixtures is made into a paste with strong vinegar just before use.

Steam, Hot Water and Hot Air Boilers and Pipes.—1.—Take of coarsely powdered iron borings, 5 lb.; powdered sal ammoniac, 2 oz.; sulphur, 1 oz., and water sufficient to moisten it. This composition hardens rapidly, but if time can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed and rammed tightly into the joint.

2.—Take sal ammoniac, 2 oz.; sublimed sulphur, 1 oz.; cast iron filings or fine turnings, 1 lb. Mix in a mortar and keep the powder dry. When it is to be used mix it with 20 times its weight of clean iron turnings, or filings, and grind the whole in a mortar; then wet it with water until it becomes of convenient consistency, when it is to be applied to the joint. After a time it becomes as hard and strong as any part of the metal.

3.—For stopping holes in castings or covering scars a useful cement may, it is said, be made of equal parts of gum arabic, plaster of paris and iron filings, and if a little finely pulverized white glass be added to the mixture it will make it still harder. This mixture forms a very hard cement that will resist the action of fire and water. It should be kept in its dry state and mixed with a little water when wanted for use.

4.—A permanent and durable joint can be made between rough cast-iron surfaces by the use of asbestos, mixed with sufficient white lead to make a very stiff putty. This will resist any amount of heat and is unaffected by steam or water.

5.—A cement, impermeable by air and steam, and especially well adapted to use for steam or gas pipes, is made of powdered graphite, 6 parts; slaked lime, 3 parts; sulphate of lime, 8 parts, and boiled oil, 7 parts; well kneaded.

6.—*Hot Air Pipes.*—Chalk, 60 parts (by measure); limestone or lime, 20 parts clay, dried and pulverized, add 2 parts; iron filings, 5 parts, and red or blue clay, 5 parts, properly mixed together, triturated and calcined.

7.—*Hot Water Cistern.*—To 4 or 5 parts clay, dried and pulverized, add 2 parts of fine iron filings free from oxide; peroxide of manganese, 1 part; sea salt, ½ part, and borax, ½ part. Thoroughly incorporate these in as fine a state as possible, reduce them to a thick paste with water and use immediately. It should then be exposed to heat, gradually increasing to almost a white heat. This cement resists heat and boiling water.

8.—*Iron Putty.*—The iron putty used for steam joints is made by mixing dry 2 parts of a good metallic paint; litharge, 1 part; fine iron borings, sifted, 3 parts, or for close joints, iron filings. Add boiled linseed oil and mix to the consistency of stiff putty.

9.—*Leaks in Boilers.*—Emergencies often arise when a leak must be stopped in a boiler while still under fire. The following preparation has been found serviceable: Mix well together powdered graphite, 6 parts; slaked lime, 3 parts; heavy spar (barytes), 8 parts, and thick linseed-oil varnish, 8 parts, and apply in the ordinary way to the spots.

10.—*Red Lead* made into a paste with boiled linseed oil is also used for cementing the joints of metal pipes.

11.—*Rust Cement.*—Make a stiff paste with sal ammoniac, 2 parts; iron borings, 35 parts; sulphur and water, 1 part, and drive it into the joint with a chisel, or to 2 parts of sal ammoniac and 1 part flowers of sulphur add 60 parts of iron chips and mix the whole with water, to which 1-6 part vinegar or a little sulphuric acid is added. Another cement is made by mixing 100 parts of bright iron filings or fine chips or borings with 1 part powdered sal ammoniac and moistening with urine; when thus prepared, force into the joint. It will prove serviceable under the action of fire.

12.—*Steam Boilers.*—a.—Mix 2 parts of finely powdered litharge with 1 part of very fine sand and 1 part of quicklime which has been allowed to slake spontaneously by exposure to the air. This mixture may be kept for any length of time without injury. In using it a portion is mixed into paste with linseed oil, or, still better, boiled linseed oil. In this state it must be quickly applied, as it soon becomes hard.

b.—Dried and powdered clay, 6 lb.; iron filings, 1 lb.; made into a paste with boiled linseed oil; used for stopping cracks and leaks in boilers, stoves, etc.

c.—Litharge in fine powder, 2 parts; very fine sand, 1 part; lime that has been allowed to slake spontaneously in a damp place, 1 part; mixed and kept from the air; made into a paste with boiled oil and used to mend cracks and secure steam joints.

d.—Good linseed-oil varnish ground with equal weights of white lead, oxide of manganese and pipeclay.

e.—Dry, powdered clay, 1 part; clean, sifted iron filings, 2 parts; acetic acid, sufficient to make a paste.

f.—Sulphate of baryta, 1 part; clay, 2 parts; made up with solutions of silicate of potash and borax; it resists a very high temperature.

g.—Iron filings, free from rust, 50 parts; flowers of sulphur, 2 parts; pulverized hydrochlorate of ammonia, 1 part; these substances are mixed with water of urine, so as to make a solid and homogeneous paste, which is used in the joints of steam boilers. The lute swells, becomes very solid, and perfectly closes the joints.

h.—Iron filings, 4 parts; loam, 2 parts; powdered sandstone, 1 part; made into a paste with salt water; becomes very hard on setting.

i.—A thick paste, composed of silicate of soda and iron filings; the latter substance may be replaced by a mixture, in equal parts, of powdered oxide of zinc and peroxide of manganese.

j.—Sand, 84 parts; Portland stone, 166 parts; litharge, 18 parts; pulverized glass, 0.99 part; red lead, 0.45 part; suboxide of lead, 0.90 part; the whole rubbed up with oil.

13.—*Stoves, etc.*—a.—The *Pharmaceutische Centralhalle* says that P. E. Richter is authority for the excellence of the following: Clay, 3 parts; borax, powdered, 2 parts; peroxide of manganese, sufficient; water glass, sufficient. Make the clay, borax and manganese peroxide into a paste with the water glass. The thickness of the paste, says the experimenter, should depend upon the size of the surfaces required to be united, and the same is true in regard to the amount and size of the grains of peroxide. The articles must be held firmly together for at least 24 hours and should not be heated until the lapse of this much time.

b.—When a crack is discovered in a stove, through which the fire or smoke penetrates, the aperture may be completely closed in a moment with a composition consisting of wood ashes and common salt, made up in paste with a little water and plastered over the crack. The good effect is equally certain, whether the stoves, etc., be cold or hot.

c.—This cement is prepared by mixing finely pulverized iron, such as can be procured at the druggist's, with liquid water glass to a thick paste, and then coating the crack with it. The hotter the fire then becomes the more does the cement melt and combine with its metallic ingredients and the more completely will the crack become closed.

d.—Take equal parts of sulphur and white lead, with about 1-6 part of borax; incorporate them so as to form one homogeneous mass. When going to apply it, wet it with strong sulphuric acid and place a thin layer of it between the two pieces of iron, which should then be pressed together. An excellent cement consists of glycerine and litharge stirred to a paste.

e.—Sand, 6 parts; iron filings, 5 parts; bone black, 5 parts; slaked lime, 6 parts; glue water, q. s.

f.—Joints.—Mica, together with finely sifted wood ashes, an equal quantity of finely powdered clay and a little salt. When required for use, add enough water to make a stiff paste.

14.—*Unaffected by Red Heat.*—a.—Iron filings, 4 parts; clay, 2 parts; fragment of a Hessian crucible, 1 part; reduce to the size of rape seed and mix together, working the whole into a stiff paste with a saturated solution of salt. A piece of fire brick can be used instead of Hessian crucible.

b.—A correspondent of the *English Mechanic* says that he used the following recipe with the greatest success for the cementing of iron railing tops, iron gratings to stoves, etc., and with such effect as to resist the blows of a sledge hammer: Take equal parts of sulphur and white lead, white about 1-6 of borax; incorporate the three so as to form one homogeneous mass. When going to apply it, wet it with strong sulphuric acid and place a thin layer of it between the two pieces or iron, which should then be pressed together. In 5 days it will be perfectly dry, all traces of the cement having vanished, and the iron will have the appearance of having been welded together.

c.—The following cement is recommended for repairing damaged places in cast-iron tanks, cisterns, etc: Brimstone, 5 parts; black lead, 2 parts, and cast-iron filings (previously sifted), 2 parts, are melted together, taking care that the brimstone does not catch fire. The damaged place, perfectly dry, is well heated by laying a piece of red-hot iron upon it, and is then stopped with the cement, previously heated in a melting ladle till it becomes soft.

d.—Equal parts sifted zinc white and manganese peroxide are mixed with soluble glass, q. s. to form a thin paste; use at once.

15.—*Water Glass Cement with Zinc and Pyrolusite.*—Water glass, 16 parts; pyrolusite, 64 parts; zinc white, 80 parts. Used for cementing the joints of pipe exposed to red heat. Hardens quickly and makes a close joint.

16.—*Water Resisting.*—Dry powdered loam or clay, 1,000 parts; fine iron filings, 80 parts; manganese, 40 parts; common salt, 20 parts, and borax, 20 parts. Mix thoroughly with water to a paste and use at once. Dry the surfaces to be cemented at a slowly rising heat and then raise to a bright red heat; the cement becomes very hard and withstands equally well boiling water or a bright red heat.

Isinglass.

Isinglass solution, 100 parts, and nitric acid, 1 part. Stir the nitric acid evenly in a very thick isinglass solution and paint the metallic surfaces with this liquid. The surfaces must be firmly pressed together. The object of the nitric acid is to make the surfaces rough by corrosion; its use, however, is attended with the disadvantage that it hinders the drying of the cement. It is therefore necessary to expose the cemented metallic surfaces to a higher temperature for a time to hasten the drying.

Linseed Oil.

Linseed oil and well slaked lime are made into a paste. Great pressure must be used.

Plumber's Cement.

Black rosin, 1 part; brick dust, 2 parts; well incorporated by a melting heat.

Pollack's Cement for Iron and Stone.

Take litharge and red lead, equal parts; mix thoroughly and make into a paste with concentrated glycerine to the consistency of soft putty; fill the crack and smear a thin layer on both sides of the casting so as to completely cover the fracture. This layer can be rubbed off if necessary when nearly dry by an old knife or chisel. M. Pollack has used it to fasten the different parts of a fly-wheel with great success. This cement is fire and water proof.

Pots and Pans, Cement for.

Two parts of sulphur and 1 part, by weight, of fine black lead; put the sulphur in an old iron pan, holding it over the fire until it begins to melt; then add the lead; stir well until all is mixed and melted; then pour out on an iron plate or smooth stone. When cool, break into small pieces. A sufficient quantity of this compound being placed upon the crack of the iron pot to be mended, can be soldered by a hot iron in the same way a tinsmith solders his sheets If there is a small hole in the pot, drive a copper rivet in it and then solder it over with this cement.

Wood and Metals.

Glue Cement.—Common glue with pulverized chalk added makes an excellent cement.

METALS TO GLASS, MARBLE, PORCELAIN, STONE, ETC.

1.—One of the best cements for uniting glass to other substances consists of a mixture of gum and calomel. Its adhesive power is something marvelous. It is prepared by putting the very best and purest gum arabic into a small quantity of water and leaving it till next day, when it should be of the consistency of treacle. Calomel (mercurous chloride or subchloride of mercury) is then added in suitable quantity, enough to make a sticky mass, being well mixed on a glass plate with a spatula. No more is to be made than that required for immediate use. The cement hardens in a few hours, but it is wiser to leave it to itself for a day or two. To insure success it is necessary to use only the very best gum; inferior sorts are absolutely useless.

2.—One lb. of shellac, dissolved in 1 pt. of strong methylated spirit, to which is to be added 1-20 part of a solution of India rubber in carbon bisulphide.

3.—Take 2 oz. of a thick solution of glue and mix with 1 oz. of linseed oil varnish or 1 oz. of Venice turpentine. Boil together, agitating until the mixture becomes as intimate as possible. The pieces cemented should be clamped together for a space of 48 to 60 hours.

4.—Sixty parts starch, 100 parts finely pulverized chalk are made into a mixture with equal parts of water and spirit and the addition of 30 parts Venice turpentine, taking care to agitate the mass with a stick, so as to insure its homogeneity.

5.—Four parts glue melted with the least possible quantity of water, 1 part Venice turpentine; will resist moisture.

6.—Rough the edges of the glass and cement with a creamy paste of plaster of paris and alum water. Make a saturated solution of alum and then add the plaster until you have a thick creamy mass. Put this into glass and then insert glass; true, and let it remain until quite hard.

7.—Rosin, 20 parts; soda, 6 parts; potassium silicate, 2 or 3 parts; water, 22 parts. A froth is obtained. This should be skimmed off and 50 parts of it mixed with 80 parts of plaster of paris (gypsum).

8.—Dissolve good glue in water, heat and add ½ as much linseed and varnish and ¼ as much Venice turpentine as the amount of glue used.

9.—Melt together finely pulverized colophony, 160 grams; white wax, 40 grams, and English red stuff, 80 grams; add to the liquid mass 20 grams of oil of turpentine; remove from the fire and stir the whole constantly with a wooden spatula until cooled.

10.—Cement the heated parts with good sealing wax, not brittle; ordinary sealing wax may be put into good condition by adding a little turpentine.

11.—Mix equal parts of shellac and very finely pulverized pumice stone; apply hot.

12.—Mix 10 parts of rosin pitch with 1 part of white wax; attach the glass with the mass thus formed.

13.—*Bismuth Cement.*—This cement is used in attaching the tops to keronese lamps. Lead, 24 parts; tin, 16 parts; bismuth, 20 parts.

14.—*Faraday's Cap Cement.*—Electrical cement. Rosin, 5 oz.; beeswax, 1 oz.; red ocher or Venetian red in powder, 1 oz. Dry the earth thoroughly in a stove at a temperature above 212°. Melt the wax and rosin together and stir in the powder by degrees. Stir until cold, lest the earthy matter settle to the bottom. Used for fastening brass work to glass tubes, flasks, etc.

15.—*Petroleum Cement.*—a.—Dissolve 5 parts of shellac and 1 part of turpentine in 15 parts of petroleum. This cement is fairly elastic.

b.—A cement particularly adapted for attaching the brasswork to petroleum lamps is made by Puscher by boiling 3 parts rosin with 1 part of caustic soda and 5 parts of water. The composition is then mixed with half its weight of plaster of paris and sets firmly in ½ to ¾ of an hour. It is of great adhesive power and not permeable to petroleum, a low conductor of heat and but superficially attacked by hot water. Zinc white, white lead or precipitated chalk may be substituted for plaster, but hardens more slowly.

Brass to Glass.

1.—Knead rosin soap with ½ the quantity of plaster of paris.

2.—Substitute zinc white for the plaster of paris or slaked lime, which causes it to harden much slower.

3.—Boil together caustic soda, 1 part;

rosin, 3 parts; gypsum, 3 parts, and water, 5 parts. The cement made in this way hardens in about ½ hour, hence it must be applied quickly. During the preparation it should be stirred constantly. Remember that all the ingredients used must be in a finely powdered state.

4.—Fresh beaten blood, 13 parts; slaked lime, 4 parts, and a little alum. This should be used immediately and applied with a brush. One or two coats will render any cloth waterproof.

Enamel Plaques to Nickel, To Cement.

Gum dammar, 10 parts; copal rosin, 10 parts; Venice turpentine, 11parts; oxide of zinc, 3 parts; ultramarine, quantities to tint the mass. Stir the coloring matter (zinc white and ultramarine) into the compound when the solids have been rendered fluid. This cement should be used hot and when cold can be polished. It is also suitable as a putty for filling up cracks in enameled surfaces.

Iron Articles in Stone.

1.—Plaster of paris, 14 parts; iron filings, 2 parts. Mix and stir into a paste with water. This cement dries quickly.

2.—Mix into a paste with water 3 lb. plaster of paris and 1 lb. iron filings.

3.—*Brick Dust Cement.*—A new cement for securing iron to stone is described in some of the foreign papers. The cement is made by melting rosin and stirring in brick dust, which must be finely ground and sifted until a sort of putty is formed, which, however, runs easily while hot. In using, the iron is set into the hole in the stone prepared to receive it, and the melted putty poured in until the space is filled; then, if desired, bits of brick, previously warmed, may be pushed into the mass and a little of the cement thereby saved. As soon as the whole is cool the iron will be firmly held to the stone and the cement is quite durable and uninjured by he weather, while, unlike lead and sulphur, it has no injurious effect on the iron.

4.—*Sulphur or Brimstone Cement.*—Roll sulphur is frequently used alone as a cement for fastening iron bars in holes drilled in stone. The addition of brick dust, sand or rosin lessens its liability to crack. When the yellow color of brimstone is an objection, a little graphite may be mixed with it.

Iron to Glass.

1.—Soak fine white glue or gelatine in water overnight. Pour off the surplus water and add molasses equal to about 25% of the bulk of glue. Heat gently and stir until the mixture is formed. The proportion of molasses can be varied to suit. Glycerine may be used instead of molasses.

2.—Portland cement, 2 oz.; prepared chalk, 1 oz.; fine sand, 1 oz.; solution of sodium of silicate, enough to form a semi-liquid taste.

3.—Litharge, 2 parts; white lead, 1 part. Work into a pasty condition by using 3 parts boiled linseed oil, 1 part copal varnish.

Metal Letters, on Glass, Marble, Wood, etc.

1.—Copal varnish, 30 parts; linseed-oil varnish, 10 parts; oil of turpentine, 10 parts; glue, 10 parts. Place the mixture in a water bath, to dissolve the glue, then add 20 parts slaked lime.

2.—Copal varnish, 15 parts; drying oil, 5 parts; turpentine, 3 parts. Melt in a water bath and add 10 parts slaked lime.

3.—Into melted rosin, 180 parts, are stirred burnt umber, 30 parts; calcined plaster, 15 parts; boiled oil, 8 parts.

4.—Rosin, 4 to 5 parts; wax, 1 part; colcothar; 1 part; the whole melted together. A little powdered plaster is often added.

5.—Sandarac or galipot varnish, 13 parts; boiled linseed oil, 5 parts; turpentine, 2½ parts; essence turpentine, 2½ parts; marine glue, 5 parts; pearl white, 5 parts; dry carbonate of lead, 5 parts; mixed

6.—Copal or lac varnish, 15 parts; drying oil, 5 parts; India rubber or gutta percha, 4 parts; coal oil, 7 parts; Roman cement, 5 parts; plaster, 5 parts.

7.—Copal or rosin varnish, 15 parts; turpentine, 2½ parts; essence turpentine, 2½ parts; fish isinglass (in powder), 2 parts; iron filings, 3 parts; ocher or rotten stone, 10 parts. These cements are much used for fixing metallic letters to glass, marble or wood. The two following are particularly good for uniting brass and glass:

8.—Caustic soda, 1 part; rosin, 3 parts; plaster, 3 parts; water, 5 parts; the whole is boiled. This compound hardens at the end of ½ an hour; the hardening may be retarted by replacing the plaster by zinc white, white lead or slaked lime.

9.—Fine litharge, 2 parts; white lead, 1 part; copal, 1 part; boiled linseed oil, 3 parts; the whole is triturated together. Dissolve by heat.

10.—For joining metallic surfaces where soldering is inconvenient recourse may be had to a composition formed in the following way: Pure and finely divided copper, such as that obtained by the reduction of sulphate of copper with zinc clippings, 20 to 36 parts, according to the degree of hardness desired in the cement, dissolved in a sufficient quantity of sulphuric acid to make a thick paste; with this is incorporated, by trituration in a mortar, mercury, 70 parts. The mass is soft, but hardens at the end of some hours. For use it is heated to 212° F. (100° C.), and powdered in an iron mortar heated to 302° F. (150° C.); it then assumes the consistency of wax and is harder in proportion, as it contains more copper.

Procelain.

Make a mixture of equal parts of water and alcohol (95% strength) and use this fluid to make a paste with 10 oz. finely powdered chalk and 8 oz. starch. Then mix in 3 oz. of Venice turpentine.

Tiles to Iron.

Use a gutta percha cement, made by melting together in an iron pan 2 parts of common pitch and 1 part of gutta percha. Stir them well together until thoroughly incorporated and then pour the liquid into cold water. When cold it is black, solid and elastic, but it softens with heat and at 100° F. is a thin fluid. Also try bedding in plaster of paris.

Tin to Wood.

Melt in a thick-walled iron vessel 1 part of yellow wax, stir in 2 parts of gutta percha chips to complete dissolution and dissolve therein 2 parts of shellac and 0.1 part of boiled linseed oil. After the mass has cooled off pour it upon a somewhat moistened metal or stone plate; next knead and shape into bars. Dry well the wooden or tin parts to be cemented and wood and tin. Press the articles together moderately and allow them to remain for 24 hours. To matt the tin by scouring with emery is advantageous. The process should not be conducted in too cool a place.

METALS TO LEATHER, CLOTH, WOOD, ETC.

Cloth to Metal.

1.—Cloth can be cemented to polished iron shafts by first painting the shafts with a coat of best white-lead paint. After the paint has dried hard coat with Russian glue, dissolved in water acidulated with a little vinegar or acetic acid.

2.—Starch, 20 parts; sugar, 10 parts; zinc chloride, 1 part; water, 100 parts. Mix the ingredients and stir until a perfectly smooth liquid results entirely free from lumps, then warm gradually until the liquid thickens.

3.—*Cloth on Iron Rolls.*—There is nothing better for this purpose than good glue, to which has been added tannin until the glue becomes ropy.

4.—*Cloth Strips to Iron, Glue.*—Soak 500 grams of Cologne glue in the evening with clean cold water in a clean vessel; in the morning pour off the water, place the softened glue without admixture of water into a clean copper or enamel receptacle and put on a moderate low fire (charcoal or steam apparatus). While the mass is dissolving stir continually with a wooden trowel or spatula. If the glue is too thick, thin with diluted spirit, but not with water. As soon as the glue has reached the boiling point add about 50 grams of linseed-oil varnish (boiled oil), with constant stirring. When the latter has been stirred up well, add 50 grams of powdered colophony and shake it into the mass with stirring, subsequently removing the glue from the fire. In order to increase the binding qualities and to guard against moisture add about 50 grams of isinglass. The latter is previously cut into narrow strips and placed, well beaten, in a vessel, into which enough alcohol is poured to cover all. When the solution has been accomplished the last-named mass is added to the boiling glue with constant stirring. The adhesive agent is now ready for use and is employed hot; it is advisable to also warm the iron. Apply glue only to so much surface as one is able to cover promptly with cloth strips. The latter are not pressed down with the hand, but with a stiff brush or a wad of cloth.

Cork to Metal.

In fastening cork to iron and brass, even when these are lacquered, a good sealing wax containing shellac will be found to serve the purpose nicely. Wax prepared with rosin is not suitable. The cork surface is painted with the melted sealing wax. The surface of the metal is heated with a spirit flame entirely free when pressed upon the metallic surface. The wax is held in the flame until it burns and it is then applied to hot surface of the metal. The cork surface painted with sealing wax is now held in the flame, and as soon as the wax begins to melt that cork is pressed firmly on the metallic surface bearing the wax.

Leather to Metal.

1.—Melt together equal parts asphalt and gutta percha and apply hot under a press.

2.—F. Sieburger recommends the following process by Fuchs: Digest 1 part crushed nutgalls with 8 parts distilled water for 6 hours and strain; macerate glue with its own weight of water for 24 hours and dissolve; spread the warm infusion of the galls on the leather and the glue on the roughened metallic surface; apply the prepared surfaces together and dry gently; the leather then adheres so firmly to the metal that it cannot be removed without tearing.

3.—Wash the metal with hot solution of gelatine and apply the leather, previously steeped in a hot infusion of galls.

4.—*Leather to Iron.*—Paint the iron with some kind of lead color, say white lead and lampblack. When dry cover with a cement made as follows: Take 1 oz. of the best glue, soak it in cold water till soft, then dissolve it in 1½ fl.oz. vinegar with a moderate heat, then add 1-3 of the bulk of white pine turpentine, thoroughly mix and by means of the vinegar make it of the proper consistency to be spread with a brush and apply it while hot; draw the leather on quickly and press it tightly in place. If a pulley, draw the leather round tightly, lap and clamp.

5.—*Leather to Iron Pulleys.*—Cut your leather roughly to shape, allowing about 1 in. per 12 in. in the width of the pulley. Then soak your leather in water until it is wet through. Now stretch it well in the direction of the circumference of the pulley and cut it to exact shape and length. It should next be sewn up, butt to butt, with a shoemaker's awl and thread, and the leather, having been stretched in the direction of circumference only, will, as it gets dry, have a tendency to resume its former shape, thereby shortening in circumference and "clip" to the pulley. A shallow groove might be made for the stitches to sink down in.

Linoleum on Iron Stairs.

Use a mixture of glue, isinglass and dextrin, which, dissolved in water and heated, is given an admixture of turpentine. The strips pasted down must be weighted with boards and brick on top until the adhesive agent has hardened.

Paper to Iron Pulleys.

Scratch the face of the pulley with a rough file thoroughly, so that there are no bright or smooth places. Swab the surface with a solution of nitric acid, 1 part; water, 4 parts (for 5 minutes); then wash with boiling hot water. Having prepared a pot of the best tough glue, stir into the glue ½ oz. of a solution of strong tannic acid, oak bark or gallnuts, as convenient to obtain, to a quart of thick glue; stir quickly white hot and apply to the paper or pulley as convenient; draw the paper as tightly as possible to the pulleys, overlapping as many folds as may be required. By a little management and moistening of the paper it will bind very hard on the pulley when dry and will not come off or get loose until it is worn out. Use strong hardware wrapping paper.

Wood to Metal.

1.—Mix together carpenter's glue, 4 parts; Venice turpentine, 1 part.

2.—Iron may be cemented in wood by dropping in the recess prepared in the latter a small quantity of a strong solution of sal ammoniac This causes the iron to rust, rendering it very difficult to extract.

3.—*Litharge and Glycerine Cement.*—A cement made of very finely powdered oxide of lead (litharge) and concentrated glycerine unites wood to iron with remarkable efficiency. The composition is insoluble in most acids, is unaffected by the action of moderate heat, sets rapidly and acquires an extraordinary hardness.

4.—*Wood and Pasteboard to Metal.*—Dissolve 50 grams of lead acetate together with 5 grams of alum in a little water. Make a separate solution of 75 grams of gum arabic in 2 l. of water, stir in this 500 grams of flour and heat slowly to boiling, stirring the while. Let it cool somewhat and mix with it the solution containing the lead acetate and alum, stirring them well together.

MICROSCOPIST'S CEMENT

1.—Put into a bottle 2 parts of isinglass and 1 part of gum arabic, cover them with proof sipirit, cork the bottle loosely and place it in a vessel of water and boil it till a thorough solution is effected, when it must be strained for use. This is a highly valuable cement for many purposes and is used for mounting opaque objects for the microscope.

2.—*Bell's Cement.*—The composition this cement or varnish is unknown. This cement is largely used by the best microscopists and has obtained a world-wide reputation.

3.—*Brunswick Black and Gold Size.*—Equal parts of Brunswick black and gold size with a very little Canada balsam.

4.—*Canada Balsam, To Thin.*—Canada balsam can be thinned with turpentine or benzol. Do not use benzol unless the balsam is quite hard. A gentle heat is desirable in order to manipulate properly.

5.—*Dammar Cement.*—Dissolve gum dammar in benzol, add 1-3 of gold size. This has the advantage of drying very quickly and may be preferably used for a first coat when glycerine is used as the material for mounting.

6.—*Glatine Cement.*—Take ½ oz. of Nelson's opaque gelatine, soak well in water, melt in the usual way, stir in 3 drops of creosote and put away in a small bottle. Use warm.

7.—*Gutta Percha Cement.*—Gutta percha cut in pieces, 1 part; turpentine, 15 parts; shellac, 1 part. Heat the gutta percha and turpentine together, filter, add the shellac (pulverized) and beat until a drop hardens on a cold glass plate. Used to attach cells; the slide must be warm when using the cement.

8.—*Lovett's Cement.*—Powdered white lead, 2 parts; powdered red lead, 2 parts; powdered litharge, 3 parts; gold size. The white and red lead and the litharge must be very finely powdered; for use, this powder is mixed with gold size to the consistency of cream and the cells immediately fastened to the slide. They are secure in 2 weeks. This stands considerable heat and is excellent for fluids containing some alcohol. Make a little only of the mixture with gold size at a time, as it hardens quite rapidly and becomes useless.

9.—*Stieda's White Zinc Cement.*—Rub up oxide of zinc with turpentine and add, stirring continually for every dram of zinc oxide, 1 oz. of a solution of dammar in turpentine of the consistency of thick syrup. For a red cement take, instead of zinc, cinnabar and take 2 dr. of the metal for each ounce of the dammar solution. If the cement has become too thick with age, dilute with turpentine, ether or chloroform.

10.—Styresin is the name of a sealing material for microscopic preparations. Dissolve solid styrax in about 5 times its weight of coal-tar benzol, slowly add petroleum benzine, stirring meanwhile. Precipitate the rosin first as a blackish-brown mass. The addition of petroleum benzine is stopped as soon as the fluid has acquired a Rhine wine color; allow to stand, filter and distil off the solvent. A substance remains which is faultless as a sealing material.

11.—*Tolu Balsam Cement.*—Tolu balsam, 2 parts; Canada balsam, 1 part; saturated solution of shellac in chloroform, 2 parts. Add enough chloroform to bring the mixture to a syrupy consistency. Carnoy finds this cement superior to all others.

12.—*Transparent Cement.*— A useful cement for affixing minute objects to thin glass covers, prior to mounting them in Canada balsam, is described in Cole's "Method of Microscopical Research." Dissolve, in the cold, gum arabic 2 gr., in distilled water 1 oz., then adding glacial acetic acid, 3 min., and the least possible trace of sugar. Filter carefully through filter paper and repeat the operation in a few weeks. This cement has been found to stand the test of use for many years, being quite unaffected by the balsam and also invisible, even under the highest powers.

RUBBER

Carbon bisulphide is the solvent most commonly employed where it is desired to make a solution of rubber. Chloroform is also widely used for this purpose, but it is more expensive. With regard to benzine, benzol, gasoline and naphtha, considerable confusion exists, the names being loosely applied to a number of hydrocarbon compounds of petroleum derivatives of varying composition. The benzine of the U. S. Pharmacopoeia is the liquid intended in nearly all the published formulas for rubber solutions. This distillate of petroleum differs from either gasoline or naphtha in being more volatile and explosive. It is characterized by a strong odor resembling that of petroleum, but much less disagreeable.

Rubber cements are very common and very useful, but great care should be taken in their preparation to guard against fire; they should not be prepared at night, as the carbon bisulphide, naphtha or chloroform is very inflammable. Vessels which are used to digest the rubber should be closed and if possible put out of doors. If heat is required, use a sand or hot-water bath; on no account bring near a fire.

To repair the lacerated article, wash the hole over wth the cement, then place a piece of linen dipped in it over the gap; as soon as the linen adheres the cement is applied as thickly as required.

1.—Caoutchouc, 1 part; mastic, 7 parts; chloroform, 50 parts. Mix and let stand until dissolved (which will require several weeks).

2.—Gutta percha, in pieces, 1 av.oz.;

carbon bisulphide, 8 fl.oz.; rosin, 40 gr. Mix and dissolve.

Hard Rubber.

1.—Dissolve bleached gutta percha in carbon bisulphide. Cement and when dry brush over carbon bisulphide in which sulphur has been dissolved.

2.—Equal parts of pitch and gutta percha are melted together and linseed oil is added, which contains litharge. Melt until all are well mixed, use no more of the linseed oil than necessary. Apply warm.

4.—Carbon Bisulphide, 26 parts; gutta percha and genuine asphaltum; apply hot to the joint, closing the latter immediately with pressure.

4.—Sulphide of carbon, 26 parts; gutta percha, 2 parts; caoutchouc, 4 parts; fish glue, 1 part. Clean the surface of fissure or parts to be united very carefully and apply the cement. The edges of the rent should be kept together by means of thread and the article left to dry. At the end of from 24 to 36 hours the binding thread may be removed and the cement which may have squeezed out of the fissure cut away.

5.—Gutta percha, 16 parts; caoutchouc, 4 parts; pitch, 2 parts; shellac, 1 part; linseed oil, 2 parts. Melt together.

6.—Melted glue, of the consistency used by carpenters, 4 parts; Venice turpentine, 1 part.

7.—Gutta percha, bleached, 4 parts; Venice turpentine, 1 part; carbon bisulphide, 32 parts. Cement, and, when dry, brush over with carbon bisulphide in which some sulphur has been dissolved.

8.—Rubber, 100 parts; rosin, 15 parts; shellac, 10 parts; bisulphide of carbon, q. s. to dissolve.

9.—Fish glue, 3 grams; gutta percha, 6 grams; India rubber, 12 grams; carbon bisulphide, 96 grams. Macerate together until dissolved. To mend tries, rubber belts and other kinds of rubber material, clean the edges of the break, if necessary strengthen by some stitches, and fill up the space by putting on thin layers of the cement, allowing them to dry somewhat before putting on additional layers. When a little more has been laid on than is needed shave off the excess with a thin, sharp knife that has been previously dipped in water.

10.—*Indianite Cement.*—a.—Finely chopped rubber, 100 parts; rosin, 15 parts; shellac, 10 parts, dissolved in a sufficient quantity of bisulphide of carbon. Used for uniting pieces of India rubber.

b.—India rubber, 15 gr.; chloroform, 2 oz.; mastic, ½ oz. The two first named to be mixed, and after the rubber is dissolved add the mastic, in powder; allow to macerate for a week. Do not bring near an open light.

11.—*Vulcanite, to Cement.*—Dissolve 1 part of sulphur and 3 parts of pure caoutchouc in 6 parts of alcohol and 100 parts of bisulphide of carbon, and evaporate to the consistency of a thin paste. Join the fractured edges with this, and heat the whole to about 310° F. for four hours.

Rubber Boots and Shoes.

1.—Caoutchouc, 62 parts; chloroform, 250 parts; mix, and dissolve. Then take caoutchouc, 60 parts; rosin, 24 parts; oil of turpentine, 250 parts. Mix, and dissolve. When complete solution has taken place in both cases, mix the 2 solutions and agitate until homogeneous. Use cold, and apply a portion of the cement to each surface to be joined.

2.—Dissolve 1 dr. of gutta percha in 1 oz. of bisulphide of carbon, filter through coarse filter paper, add 15 gr. of pure rubber, rub the whole smooth with a palette knife, taking care to do it quickly. If necessary, thin with bisulphide of carbon. Keep it away from fire or light as it is volatile and inflammable.

Rubber Hose.

The damaged part, previously well cleaned and dried, is painted over with hot oil of turpentine. A thin sheet of gutta percha, softened by heat, is put around it so that the edges meet, and is pressed against the hose with a knife blade. The edges are finally cemented together by touching the seam with a moderately hot iron rod.

Rubber to Wood, Glass, Metal, etc.

1.—Soak powdered shellac in 10 times its weight of strong water of ammonia, whereby a transparent, gelatinous mass is produced. Melt by placing the vessel in hot water. When using the cement the surfaces of the rubber and the substance to be cemented are coated with the liquid mass and then firmly pressed together. So soon as the ammonia has evaporated the rubber hardens, and the joints are as firm as the rubber.

2.—*Hard Rubber to Metal.*—Make a thin solution of glue, and gradually add pulverized wood ashes till you have a stiff varnish. Use this cement hot.

Rubber, to Fasten to Metal.—This may be done by employing a cement which fastens alike well to the rubber and to the metal or wood. Such cement is prepared by a solution of shellac in ammonia, best made by soaking pulverized gum shellac in 10 times its weight of strong ammonia, when a shining mass is obtained, which in 3 or 4 weeks will become liquid without the use of hot water. This softens the rubber, and becomes, after volatilization of the ammonia, hard, and impermeable to gases and fluids.

Tire to Rim, Leather.

Carbon bisulphide, 19 parts; oil of turpentine, 1 part; gutta percha, cut in small pieces, q. s. Mix the turpentine and carbon bisulphide, and add sufficient gutta percha, under frequent agitations, or rubbing up, until a thick paste is obtained. To make a good joint, all fatty and greasy matter must be got rid of.

Tire to Rim, Rubber.

A good, thick shellac varnish, with which a small amount of castor oil has been mixed, will be found a very excellent rim cement. The formula recommended by Edel is as follows:

1.—Shellac, 1 lb.; alcohol, 1 pt.; mix, and dissolve, then add castor oil, ½ oz. The cast or oil prevents the cement from becoming hard and brittle.

2.—Melt together, at a gentle heat, equal parts of gutta percha and asphalt. Apply hot. Sometimes a small quantity each of sulphur and red lead are added (about 1 part of each to 20 parts of cement).

3.—Shellac, 2 av.oz.; gutta percha, 2 av.oz.; red lead, 90 gr.; sulphur, 90 gr. Melt the shellac and gutta percha, and add, with constant stirring, the red lead and sulphur, melted. Use while hot.

4.—Pitch, 2 parts; gutta percha, 1 part; melted together. Use hot.

Tire Punctures.

1.—A patented preparation for the automatic repairing of punctures in bicycle tires consists of glycerine holding gelatinous silica or aluminum hydrate in suspension. Three volumes of glycerine are mixed with 1 volume of liquid water glass, and an acid is stirred in. The resulting jelly is diluted with 3 additional volumes of glycerine, and from 4 to 6 oz. of this fluid are placed in each tire. In case of puncture, the internal pressure of the air forces the fluid into the hole, which it closes.

2.—Gutta percha, 1 oz.; caoutchouc, 2 oz.; Venice turpentine, 1 oz.; carbon bisulphide, [illegible] oz. Dissolve the gutta percha and caoutchouc in the carbon bisulphide and add the Venice turpentine.

3.—India rubber, 15 gr.; chloroform, 2 oz.; mastic, 4 dr. First mix the India rubber and chloroform together, and, when dissolved, the mastic is added in powder. It is then allowed to stand for a week or two before using.

4.—a.—Caoutchouc, fine shreds, 1 oz.; chloroform, 20 oz.

b.—Caoutchouc, fine shreds, 1 oz.; rosin, 3 dr.; Venice turpentine, 90 grams; oil turpentine, 2 oz. For the solution b, the rubber is shaved into small pieces and melted with the rosin; the Venice turpentine is then added, and all is dissolved in the oil of turpentine. The two solutions, a and b, are then mixed.

5.—Crude rubber, ½ oz.; carbon bisulphide, 4 oz. Macerate 24 hours, and then add a solution of rosin, 1 oz.; beeswax, ¼ oz.; carbon bisulphide, 4 oz.

6.—Bisulphide of carbon, 160 parts; gutta percha, 20 parts; caoutchouc, 40 parts; isinglass, 10 parts. This cement is dropped into the crevices after they have been properly cleaned. If the rent is very big, apply the cement in layers. Bind up the rubber tightly with thread, let it dry for 24 to 36 hours; cut off the thread, and remove the protruding cement with a sharp knife, which must previously have been dipped in water.

7.—A rubber cement, which comes upon the market in tin tubes, is made of unvulcanized rubber (the so-called "waste" is the cheapest) dissolved in benzine, or also in benzol or sulphide of carbon. It has the consistency of a salve. The solution, in wide-necked, well-sealed bottles, takes a day or two.

WOOD TO WOOD, METAL, GLASS STONE

1.—*Ash Cement.*—Warm good cabinetmakers' glue with water to the consistency necessary to connect wooden objects; then add enough sifted ashes to bring it to the thickness of a varnish. The cement should be applied to the surfaces of the objects, to be united when warm, and then they should be pressed together tightly. After cooling and drying, the surfaces are so strongly united as to required great force to separate them Grinding stones fastened on wood, and handles to painters' stones for grinding colors, have been used for more than a year without exhibiting any appearance of fracture.

2.—*Cloth or Leather to Table-tops.*—Wheat flour, 2¼ lb.; powdered rosin, 4 tablespoonfuls; powdered alum, 2 tablespoonfuls; heat, and mix to a stiff consistency.

3.—*Emery to Wood.*—Melt together equal parts of shellac, white rosin and carbolic acid, in crystals; add the last after the others are melted. The effect of the carbolic acid is surprising.

4.—*Filling Cement for Holes in Wood.* a.—Mix together rosin and turpentine, 1 pt. each, over a water bath, and add 2 pt. common burnt ocher. Have the work dry.

b.—Put any quantity of fine sawdust of the same kind of wood into an earthen pan, and pour boiling water on it; stir it well, and let it remain for a week or 10 days, occasionally stirring it; then boil it for some time, and it will be of the consistency of pulp or paste; put it into a coarse cloth and squeeze all the moisture from it. Keep for use, and, when wanted, mix a sufficient quantity of thin glue to make it into a paste; rub it well into the cracks, or fill up the holes in your work with it. When quite hard and dry, clean the work off, and, if carefully done, you will scarcely discern the imperfection.

c.—Dissolve 1 part of best glue in 16 parts of water, and when almost cool stir in sawdust (hardwood) and prepared chalk in a sufficient quantity. Oil varnish, thickened with a mixture of equal parts of white lead, red lead, litharge and chalk.

d.—The following cement will be as hard as stone when dry, and will adhere firmly to wood: Melt 1 oz. of rosin and 1 oz. of pure yellow wax in an iron pan and thoroughly stir in 1 oz. of Venetian red until a perfect mixture is formed. Use while hot. When cold it is as hard as stone.

e.—Pulverized slaked lime, 1 part; rye flour, 2 parts; mixed with linseed-oil varnish. It takes any desired color and polish.

f.—Steep white tissue paper in water until perfectly soft, thoroughly knead with glue until transformed into a paste; by means of ochers (earth colors), color as nearly as possible to the shade of the wood; add calcined magnesia; force into the cracks or holes. This cement attaches itself very firmly to the wood, and after drying retains its smooth surface.

5.—*Mahogany Cement.*—a.—Beeswax, melted, 4 oz.; then add Indian red, 1 oz., and enough yellow ocher to produce the required tint.

b.—Shellac, melted, and colored as above. Very hard. Used to fill up holes and cracks in mahogany.

6.—*Resinous Cement for Coating Wood.*—This cement is fairly acid-proof, and resists alkalies. Melt 3 parts rosin, 1 part asphaltum and 2 parts brick dust. Use hot.

7.—*Stone to Wood.*—Melt together 4 parts pitch and 1 part wax, and add 4 parts brick dust or chalk. Warm for use, and apply thinly to the surfaces to be joined.

8.—*Tinfoil to Wood.*—The following is said by the *Papierzeitung* to be a good formula for a paste for lining drawers, to hold seed, tobacco, etc.. Dissolve rye flour to a syrupy consistency in a solution of sodium carbonate. Warm Venetian turpentine, and pour into the paste; a few drops will suffice for 1 lb. of the flour. An ordinary starch paste may be used instead of rye. The best process, however, is to rub the leaves of tinfoil with onion juice, let dry, and then use any animal or vegetable glue, or paste, in sticking it on. Any good glue of animal origin, to which hydrochloric acid has been added, answers the purpose, but should be smeared on the wood, not on the foil.

CEMENTS FOR MINOR SPECIAL USES AND OF SPECIAL MATERIALS

Abolithe Cement.—A new cement, stated to possess excellent hardening qualities, is made by calcining magnesite (the carbonate of magnesia) in ovens similar to those used for gas-making, after which it is pulverized, and mixed with a quantity of fine silica. The cent is declared to possess great hardness and durability. It may be molded like plaster; it may be used to replace the dilapidated stones of a building, and adheres with so much tenacity to wood that its application as a preserver of timbers, railways sleepers, etc., by painting it upon the surface, has been tried with success.

Alabaster, To Mend.—1.—(See also MARBLE).—Add ½ pt. of vinegar to ½ pt. of skimmed milk. Mix the curd with the whites of 5 eggs, well beaten, and sufficient powdered quicklime sifted in, with constant stirring, so as to form a paste.

2.—Plaster of paris, rosin (yellow), beeswax, equal parts.

3.—Rice glue thickened with finely powdered quicklime.

4.—Yellow rosin, 2 parts; melt, and stir in 1 part plaster of paris; rosin, 8 parts; wax, 1 part; melt, and stir in plaster of paris.

Alcohol, Cement to Resist.—Take the best kind of glue, pour on an equal quantity of water; let it soak overnight; next morning melt it over a gentle heat and add fine Paris white or white lead; mix well, and add a little acetic acid, carbolic acid, oil of cloves, or any other ethereal oil, to prevent putrefaction. This cement is also adapted for flexible objects like leather. It will not withstand boiling water well, as this softens the glue.

Badigeon.—Cement used to cover up unavoidable holes or defects in workmanship. Many formulas. Every trade has its own. Putty, plaster of paris, sawdust and glue are extensively used for this purpose.

Benzine and Petroleum, Cement to Resist.—It has quite recently been discovered that gelatine mixed with glycerine yields a compound liquid when hot, but which solidifies on cooling, and forms a tough, elastic substance, having much the appearance and characteristics of India rubber. The two substances united form a mixture entirely and absolutely insoluble in petroleum or benzine, and the great problem of making casks impervious to these fluids is at once solved by brushing or painting them on the inside with the compound. This is also used for printers' rollers and for buffers of stamps, as benzine or petroleum will clean them when dirty in the most perfect manner, and in an incredibly short space of time. Water must not be used with this compound.

Bisque, Cement for.—Burn some oyster shells, reduce to powder in a muller, and pass through a fine sieve; make this into a paste with white of egg. The shells should be thoroughly cleaned, well burned, air-slaked, and finely powdered, making simply a fine article of lime. The parts joined must be held firmly together for two minutes or so after the cement has been applied. Be sure the parts are thoroughly clean before joining.

Bisulphide of Carbon, Cement Impervious to.—Best quality of white glue with 10% of molasses added.

Black Cement.—Blacksmith's ashes, 1 lb.; sharpy sand, 1 lb.; rosin, 2 lb.

Bone Cement.—1.—Take of isinglass, 1 oz.; distilled water, 6 oz.; boil to 3 oz., and add rectified spirit, 1½ oz.; boil for a minute or two, strain, and add while hot: first, a milky emulsion of gum ammoniac, ½ oz., and then tincture of mastic 5 dr.

2.—White Cement for Bone.—If only to fill up cracks, try lime and white of egg, made into a paste, or ground rice flour mixed with water.

Bottger's Cement.—Bottger's cement, made with fine precipitated chalk, stirred into a solution of sodium silicate at 33° B., to which pigments may be added, if desired, the mixture hardening in 6 or 8 hours.

Bottle Cements.—1.—A number of these cements will be found under *Wax*, where they are properly placed. See also *Massiat's*, *Chemical*, and *Glycerine Cements.* Copal varnish, made thick with red lead or other pikment, affords an excellent bottle cement.

2.—Mix gelatine and glycerine, apply warm, by dipping the neck of the bottle in the mixture. Repeat if necessary.

3.—Cement for sealing fruit cans is made of rosin, 1 lbs.; tallow, 1 oz.

Brown Cement.—Pure gum rubber, 20 gr.; carbon bisulphide, q. s.; shellac, 2 oz.; alcohol, 8 oz. Dissolve the rubber in the smallest possible amount of the carbon bisulphide; add this slowly to alcohol, avoiding clots; add powdered shellac, and place the bottle in boiling water until the shellac is dissolved and no more smell of carbon bisulphide is given off.

Casks and Cisterns, Air- and Water-tight Cement.—Melted glue, 10 parts; linseed oil, 5 parts; boil into a varnish with litharge. Hardens in 2 days.

Cement Pipe.—The proper proportion for cement pipe is 1 of water cement to 3 of sand. Gravel from the size of a pigeon's egg down is better than fine sand, and it must be perfectly clean and free from mold or vegetable matter. The cement and sand must be thoroughly mixed before the water is added, and it must be used immediately after mixing. The most common cause of failure is a poor quality of cement.

Chinese Cement (Schio-liao).—1.—To 3 parts of fresh beaten blood are added 4 parts of slaked lime and a little alum; a thin, pasty mass is produced, which can be used immediately. Objects which are to be made specially waterproof are painted by the Chinese twice, or at the most three times.

2.—Pasteboard treated therewith receives the appearance and strength of wood. Most of the wooden public buildings of China are painted with schio-liao, which gives them an unpleasant reddish appearance, but adds to their durability. This cement was tried in the Austrian Department of Agriculture, and by the Vienna Association of Industry, and in both cases the statements of Dr. Scherzer were found to be strictly accurate.

3.—Chinese glue is made by covering shellac with strong liquid ammonia and shaking frequently until dissolved. The solution takes some time to form, and is facilitated by standing, placing, the bottle, well stoppered, in a moderately warm situation, and briskly agitating it at intervals. Bleached shellac gives a lighter colored cement, but it is not considered as strong. This cement is not particularly recommended.

4.—Finest pale orange shellac, broken small, 4 oz.; rectified spirit (the strongest 58 o. p.), 3 oz.; digest together in a corked bottle in a warm place until dissolved; it should have the consistency of molasses.

Chinese Blood Cement.—This cement is in general use in China for making wooden and pasteboard vessels, willowware, etc., waterproof. Slaked lime, 50 parts; beaten bullock's blood, 37½ parts; alum, 1 part. Mix together.

Clock Faces, Cement for White Enameled.—Dammar, 50 parts; gum copal, 50 parts; Venice turpentine, 55 parts; zinc white, 30 parts; ultramarine, 1 to 2 parts. Apply the cement hot, and polish when entirely cold.

Cloth, Cement far.—1.—Use thin sheet gutta parcha, which can be purchased of the manufacturers, especially for tailors' use. Place a piece of the tissue between the layers of cloth to be cemented, and press with a hot iron. This causes the cloth to firmly adhere on account of the melting of the gutta percha.

2.—Gutta percha, 16; caoutchouc, 4; pitch, 2; shellac, 1; linseed oil, 2.

Collodion Cement.—Powdered nitrate of potash, 1 dr.; concentrated sulphuric acid, 1½ dr.; carded cotton, 5 dr. The nitrate of potash and the acid should be mixed in a porcelain capsule, gradually add the cotton, and stir for 5 minutes. Wash it thoroughly in clear water, pull it apart, and dry—not near the fire, as it is a species of guncotton. Dissolve in rectified sulphuric ether and a little alcohol. It will form a transparent, colorless and strong adhesive cement.

Colored Cements.—According to the *Seifen Zeitung*, a water-glass solution of 25° B., thickened with the following materials, produces cements of the colors named, as follows: Finely sifted antimony sulphide, black; cast-iron, in finest powder, green-black; zinc dust, gray; copper carbonate, light green; chrome oxide, dark green; cobalt blue, blue; red lead, orange; cinnabar, bright red; carmine, violet red.

Corks, etc., Cement for.—1.—Zinc white, rubbed up with copal varnish to fill up the indentures; when dry, to be covered with the same mass, somewhat thinner; and lastly, with the copal varnish alone. Plain shellac varnish will often answer the purpose.

2.—Corks boiled in paraffine resist the action of the atmosphere, also worms and insects.

Crocus Cement.—Crocus, mixed with a little linseed oil, makes a hard and useful cement.

Crucible.—1.—A mixture of powdered clay and brick dust, made up with water, or a solution of borax. Used to join crucibles which are exposed to a strong heat. When mixed up with borax solution the lute becomes a compact vitreous mass in the fire.

2.—Form a paste with water of 2 parts borax, 2 parts slaked lime, and 1 part litharge. Can also be used for porcelain.

Cue Tips, Cement for.—Russian isinglass, 1 oz.; distilled water, 2 fl.oz.; glycerine, 2 fl.dr.; glacial acetic acid, 1 fl.oz. Mix.

Cutler's Cement.—1.—For fastening blades of dinner knives in ivory handles. Consists of rosin, 4 parts; beeswax, 1 part; plaster of paris or brick dust, 1 part. Fill the hole in the handle with the cement, heat the tang of the blade, crowd in, and remove superfluous cement.

2.—Rosin, 16 oz.; hot whiting, 16 oz.; wax, 1 oz.

3.—Pitch, 5 parts; wood ashes, 1 part; hard tallow, 1 part; melted together.

4.—Black rosin, 4 lb., melted with 1 lb. beeswax, and 1 lb. red-hot whiting added.

Davy's Cement.—Davy's universal cement is made by melting 4 parts common pitch with 4 parts gutta percha in an iron vessel, and mixing well. It must be kept fluid, under water, or in a dry, hard state.

Diamantkitt.—A German cement, according to Hager. Graphite, 50 parts; litharge, 15 parts; milk of lime, 10 parts; slaked lime, 5 parts; intimately mixed with enough linseed oil to make a firm mass.

Diamond Cement.—The following formula will be found useful in repairing china, glass, wood, leather, etc.: Isinglass, 240 gr.; mastic, 120 gr.; gum ammoniac or galbanum, 60 gr.; alcohol, 4 fl.oz.; water, 4 fl.oz. Soak the isinglass in the water for 24 hours; evaporate on a water bath to 2 fl.oz.; then add 2 fl.oz. of alcohol; strain; add the mastic, dissolved in the remaining alcohol, and add the ammoniac by trituration, avoiding loss of alcohol as much as possible.

Egg Cements.—1.—These are useful household cements. Use white of an egg.

beaten up with an equal quantity of water; add enough slaked lime to make a paste; apply immediately.

2.—Plaster of paris, with the addition of ¼ its weight of lime, and q. s. of white of egg. Reduce the lime, which should be freshly slaked, to a fine powder. Mix quickly, apply immediately, and allow it to remain undisturbed for at least 3 days.

Evans' Cement.—Cadmium, 26 parts; mercury, 74 parts; dissolve this amalgam in an excess of mercury, knead thoroughly, and heat if necessary, so that the cement is plastic as wax.

Flexible Cement.—Flexible cement is composed of white pitch and gutta percha, equal parts. mixed over a water bath. Many of the other gutta percha and rubber cements answer for flexible cements.

French Cement.—Gum water, thickened with starch; a little lemon juice is sometimes added.

Gas Bags, Cement for.—Add 1 part of glycerine to very thick boiled glue. Fill the bag with air and apply while warm; if too sticky, strew it with a little powdered soapstone. For large rents use leather well covered with glue.

Gas Fitters' Cement.—Melt together 4½ parts rosin (by weight), 1 part beeswax; then stir in 3 parts Venetian red, and pour into molds made of oiled paper or iron.

Gas Retorts, Cement for.—For cementing earthenware gas retorts, which have to withstand very high temperatures, the following cement can be used: Powdered glass, 5 parts; chamotte meal, 5 parts; powdered borax, 1 part. Chamotte meal is obtained by pulverizing broken pieces of gas retorts. This cement is a hard glass, which only melts at the highest temperatures, then closes the leaks in the retort. To render airtight the iron cover which closes the retort, a cement is used consisting of schwerspath powder, to which as much soluble glass has been mixed as to obtain a paste of sufficient strength.

Gases. To Resist.—1.—Clay is dried, powdered, sifted, placed in an iron mortar, and incorporated with drying oil, added gradually, the whole being well beaten up till the mass assumes the consistency of a fine paste. It should be preserved under a coating of oil, to prevent is drying up. It resists the action of corrosive gases, but inconveniently softens by exposure to heat.

2.—Plaster of paris, mixed with water, milk, or weak glue. Stands a dull-red heat.

Glass Cement.—1.—Take pulverized glass, 10 parts; powdered fluorspar, 20 parts; soluble silicate of soda, 60 parts. Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each in fine powder, with water, allowing the coarser particles to deposit, and then to pour off the remainder, which holds the finest particles in suspension. The mixture must be made very rapidly, by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

2.—Red lead and boracic acid, equal parts; add white sand, 2-3 part; mix; reduce to very fine powder, make into a paste with dilute sodium silicate. Apply as an ordinary cement, and heat high enough to fuse the water glass.

Gram-Rutzon's Cement.—Hard Canada balsam, 50 grams; shellac, 50 grams; absolute alcohol, 50 grams; anhydrous ether, 100 grams. The ingredients are mixed, and, when the gums are dissolved, filter, if necessary, and evaporate, away from the flame, over a water bath, until of syrupy thickness.

Grouville's Oil Cement.—White lead, 1¼ parts; red lead, ½ part; dry clay, 1 part. Mix with boiled linseed oil.

Gutta Percha Cement.—1.—Valuable for many purposes, especially where the article is not required to be fireproof. (See caution under *Rubber Cements.*) This highly recommended cement is made by melting together in an iron pan 2 parts common pitch and 1 part gutta percha, stirring them well together until thoroughly incorporated, and then pouring the liquid into cold water. When cold it is black, solid and elastic; but it softens with heat, and at 100° F. is a thin fluid. It may be used as a soft paste, or in the liquid state, and answers an excellent purpose in cementing metal, glass, porcelain, ivory, etc. It may be used instead of putty for glazing windows.

2.—Fuse together equal parts of gutta percha and pitch. Use hot.

3.—Fuse together equal parts of pitch and gutta percha, and to this add about 2 parts of linseed oil containing 5 parts of litharge. Continue the heat until the ingredients are uniformly commingled. Apply warm.

Gutta Percha, Cement for.—1.—Stockholm tar, 1 part; rosin, 1 part; gutta percha, 3 parts.

2.—Rosin, 2 parts; Stockholm tar, 2 parts; gutta percha, 4 parts.

Hagar's Cement.—Graphite (elutriated), 500 parts; whiting, 150 parts;

litharge, 150 parts. Mix with linseed-oil varnish to form a stiff putty.

Hensler's Cement.—Litharge, 6 parts; quicklime, 4 parts; white bole, 2 parts. Grind with boiled linseed oil. Though tenacious, it is not recommended, on account of time required to set.

Hoenle's Cement.—This is composed of shellac and Venice turpentine. Shellac, 2 parts; turpentine, 1 part. Melt, and mold into sticks.

Hoofs of Horses, Cement for.—Use gutta percha, 2 parts; gum ammoniac, 1 part. Heat the gutta percha and gradually add the gum ammoniac, which must be very finely powdered. Heat for use.

Household Cement.—Alum and plaster of paris, well mixed in water, and used in the liquid state, form a hard composition and also a useful cement.

Filaments, Cement Lamp Incandescent for.—Take 100 gr. of carburet of iron (Dixon's stove polish), grind dry to a fine powder, add 10 gr. of lump sugar, mix well in a mortar; then add 40 gr. gold bronze, mix again; then add sufficient water to make a thick paste, and apply it to the junction between the carbon and the platinum wire; allow it to stand for 20 minutes or so, then burn the point to a cherry-red heat by a fine gas flame.

Insuleting Cement.—Shellac. 5 parts; rosin, 2 parts; Venice turpentine, 1 part; yellow ocher, 3 parts.

Insuleting Tapes, Cement for.—1.—Pure gum rubber, dissolve in turpentine, with the addition of 5% of raw linseed oil.

2.—Yellow pitch, 8 parts; beeswax, 2 parts; tallow, 1 part.

Insulators, Cement for.—Sulphur, lead, plaster of paris, with a little glue to prevent it setting quickly.

Iron and Blood Cement.—Pulverized lime, 100 parts, triturated with bullock's blood, 290 parts cement, and from 5 to 10 parts iron filings.

Jannin's Cement.—This is known as Jannin's cement, from the name of the patentee (patent now expired). The cement is simply a mixture, in suitable proportions, of yellow oxide of lead (the quality known as massicot being preferable) with glycerine. Several other metallic oxides and matters may be mixed with the cement, so as to suit the quality or the color of the cement to the nature of the work to be produced, but the two essential compounds are yellow oxide of lead and glycerine. The proportions of oxide of lead and glycerine vary according to the consistency of the cement it is desired to produce. The proportion of glycerine will, of course, be larger for a very soft cement than for a stiff cement; it is not necessary, therefore, to specify the exact proportion of each of the two essential compounds. This cement is specially adapted for molding those objects which require an extreme delicacy in the lines of the cast, such as engraved blocks and plates, forms of printing type, photoglyptic plates, etc. Under the influence of gentle heat it sets in a few minutes, and then resists perfectly both pressure and heat. When set, it is also a very good substitute for natural lithographic stones, and it can replace them for many practical purposes. It can also be used for artistic reproductions, such as fac-similes of terra cotta, whose color and sonorous quality it possesses. Though setting to great hardness in a few minutes, it does not shrink.

Lime Cements.—Lime cements are very valuable in mending many articles, and when combined with casein, sodium silicate, or egg, produce one of the simplest and most durable cements for household used.

Lime and Glue Cement.—Into hot glue stir air-slaked lime. This gives a good cement, and very cheap.

Litharge Cement.—Litharge, 1 oz.; plaster of paris, 1. oz.; finely powdered rosin, 1-3 oz.; mix thoroughly, and make into a paste with boiled linseed oil to which driers have been added. Beat it well, and let it stand 4 or 5 hours before using. Soda silicate and chalk make a good cement.

Marteaux & Robert's Cement.—Pyrolusite, finely powdered, 100 parts; graphite, 12 parts; white lead, 5 parts; red lead, 5 parts; clay, 3 parts. After sifting and mixing, 1 part of boiled linseed oil to each 7 parts of the mixture is added. Make into a paste, heat, and pound; repeat the operation several times.

Mastic Cement.—1.—Mastic cement is used for molding ornaments, etc. Reduce all materials to fine powder. Quartz sand, 20 parts; limestone, 20 parts; litharge, 10 parts; linseed oil, 7 parts.

2.—Powdered slaked lime, 30 parts; sand, 17½ parts; litharge, 1½ parts. Knead to a stiff mass with 3½ to 5 parts of oil linseed oil, or linseed-oil varnish may be used. Work thoroughly in a mortar, with a pestle.

Mending Tissues.—1.—Caoutchouc, 5 parts; chloroform, 3 parts; dissolve, and add gum mastic (powder), 1 part.

2.—Gutta percha, 16 parts; India rubber, 4 parts; pitch, 2 parts; shellac, 1 part; linseed oil, 2 parts. Reduce solids to small pieces. Melt togther with the oil. Mix well.

3.—Bisulphate of carbon, 8 oz.; gutta percha, ½ oz.; rosin, 40 grams. Mix.

Metallic Cement.—From 20 to 30 parts of finely divided copper, obtained by the reduction of oxide of copper with hydrogen, or by precipitations from solutions of its sulphate with zinc, are made into a paste with oil of vitriol, and 70 parts of mercury added, the whole being well triturated. When the amalgamation is complete the acid is removed by washing with boiled water, and the compound allowed to cool. In 10 or 12 hours it becomes sufficiently hard to receive a brilliant polish, and to scratch the surface of tin or gold. By heat is assumes the consistency of wax, and as it does not contract by cooling, it is recommended by a noted chemist for dentists' use for stopping teeth. This is a splendid cement for attaching to the surface of wood, glass, metal and porcelain.

Mica, Cement for.—A colorless cement for joining sheets of mica is prepared as follows: Clear gelatine is softened by soaking it in a little cold water, and the excess of water is pressed out by gently squeezing it in a cloth. It is then heated over a water bath until it begins to melt, and just nough hot proof spirit (not in excess) stirred in to make it fluid. To each int of this solution is gradually added, while stirring, ¼ oz. of gum* ammoniac and 1 1-3 oz. of rectified spirit. It must be warmed to liquefy it for use, and kept in stoppered bottles when not required. This cement, when properly prepared, resists cold water.

Mohr's.—Equal parts of pulverized brick and litharge are made into a paste with linseed oil. After application a little fine sand is dusted over the lute, and it is dried in the oven.

Muirhead's Cement.—Portland cement, 3 lb.; sharp sand, 3 lb.; blacksmith's ashes, 4 lb.; rosin, 4 lb. Melt the rosin and stir the other ingredients in.

Oil and Sulphur.—One part of sulphur to 12 of oil gives a substance like molasses; 4 parts of sulphur to 12 of oil a stiff substance like rubber. To be successful in making this compound take an iron ladle, such as is used for the melting of lead, and fill it not more than one-third full, and place it over a clear fire. Owing to a quantity of water being held in the oil by the vegetable matter, it will begin to seethe, and if not closely watched boil over into the fire. After a little time it will subside, the surface remaining quite placid, with now and then little flickers of smoke flitting across the surface. Your sulphur must be either roll brimstone or the crude sublimed—*i.e.*, not washed or treated with acid. If the first, finely powder it, and mix by degrees in the oil, stirring all the time until incorporated.

Opticians' Cement.—1.—Shellac, softened with rectified spirit or wood naphtha. For fine work.

2.—Beeswax 1 oz.; rosin, 15 oz. Melt, and add whiting (previously made red hot, and still warm), 4 oz.

3.—Rosin, 1 lb.; melt, and add plaster of paris, dry, 4 oz. The above are used to fix glasses, stones, etc., while polishing and cutting them. The last is a very strong cement for rough purposes.

4.—Rosin, 10 parts; shellac, 2 parts; rough, 1 part. Melt, mix, and add enough turpentine to make it tough, so as not to splinter under pressure form the thumbnail, at the working temperature of the room.

Papier Mache, Architectural Cement. —1.—Strong rice-water size and paper pulped in boiling water, are mixed together; enough whiting is then added to make it of a proper consistency. The paper must be perfectly pulped.

2.—Make the cement the same, only substitute plaster of paris for whiting.

Parabolic.—Syn. Universal Cement.—Curdle skim milk, press out the whey, and dry the curd by a gentle heat, but as quickly as possible. When it has become quite dry, grind it to powder in a coffee or pepper mill, and mix it with 1-10 of its weight of finely powdered quicklime, and a piece of camphor the size of a pea, also reduced to powder, to every ounce of the mixture. Keep it in wide-mouthed 1-oz. vials, well corked. For use, make it into a paste with a little water, and apply it immediately.

Pasteboard, To Cement.—Good pitch and gutta percha (about equal parts) are fused together, and to 9 parts of this are added 3 parts of boiled oil and 1-5 part of litharge; continue the heat, with stirring, until thorough union of the ingredients is effected. This is applied hot, or cooled somewhat, and thinned with a small quantity of benzole or turpentine oil.

Pestles, Cement for Mending.—1.—Plaster of paris is ordinarily used for fastening loose handles. It is made into a moderately thick paste with water, run into the hole in the head of the pestle, the handle inserted, and held in place till the cement hardens. Some add sand to the paste, and claim to get better results.

2.—Boil together 1 part of caustic soda, 3 parts of rosin, and 5 parts of water, till homogeneous, and add 4 parts of plaster of paris. The paste sets in half an hour, and is but little affected by water.

3.—Equal quantities of gutta percha and shellac are melted together and well stirred. This is best done in an iron capsule placed on a sand bath and heated over a gas furnace or on the top of a stove. It is a combination possessing both hardness and toughness, qualities that make it particularly desirable in mending mortars and pestles. In using, the articles to be cemented should be warmed to about the melting point of the mixture, and retained in proper position until cool, when they are ready for use.

Patent Fuel Cement.—This cement, used for the agglomeration of coal dust, and the manufacture of patent fuel, consists of coal tar, gluten and starch. The qualities of these substances vary according to the quality and property of coal dust. About 2% of this mixture (say containing 2½ parts tar, 1 part gluten, ½ part starch) would be suitable for coal dust of an average quality of bituminous coal.

Pew's Cement.—Prep. Powdered quicklime, 1 part; powdered baked clay, 2 parts; mix, then add 1 part of freshly baked and powdered gypsum to 2 parts of powdered baked clay, and after mixing well add them to the former powder and thoroughly incorporate the two. Used to cover buildings. It is mixed with water, and applied like mortar. It acquires great hardness, and is very durable.

Plaster Cement.—1.—Plaster of parts, baked and ground, acquires great hardness and solidity when left for 24 hours in contact with a. solution of alum, and when, after drying in the air, it is submitted to a second baking.

2.—A mixture of silicate of potash, 100 parts; carbonate of potash, 27 parts; and water, 50 parts, may also be used.

4.—Plaster of paris busts, etc., are best mended with shellac varnish or soluble glass.

Prisms, Bisulphide of Carbon, Cement for.—For bisulphide of carbon prisms, Mr. Lewis M. Rutherford, who has had much experience in this subject, employs a cement of glue and molasses. The surfaces must be perfectly clean; they are then warmed, and dusted with a fine camel's-hair brush, and placed in contact. A hot and fluid mixture of glue and molasses is then applied around the edges, and penetrates by capillary attraction. It must be left a day or two to harden before preparing the next side. The ground stopper was also rendered tight by a little molasses.

Quicklime Cement.—Dilute white of egg with its bulk of water, and beat up thoroughly. Mix to the consistency of thin paste with powdered quicklime. Must be used immediately.

Resinous Cements are excellent in all cases where heat is not applied, and they are very inexpensive.

Scheibler's Cements.—Melt 1 part of wax and 3 parts of shellac, and work into the mixture, while still warm, 2 parts of gutta percha, cut fine.

Schottler's Cement.—Plaster of paris, freshly ground, 12 parts by weight; cinders, sifted, 8 parts; brick dust, 6 parts. Mix with water.

Serbat's Linseed-Oil Mastic.—Lead sulphate, 6 parts; mix with 1 part linseed; add gradually; add 6 parts powdered pyrolusite.

Shellac Cement.—For fastening leather, wood, stone, etc., to metal or other substances: (a) Orange shellac, 4 oz.; (b) concentrated ammonia, 8 fl.oz.; distilled water, 6 fl.oz. Weigh out (a), place in a quart fruit jar, and add (b). Seal up the cover so as to prevent evaporation, and set aside. In about 6 days the shellac will be perfectly dissolved, especially if the mixture be shaken occasionally. In order to use this cement it should be poured into a shallow dish and evaporated until quite thick and gummy. If you get it too thick it is easily thinned with a little hot water. The only objection to this cement is the color, which assumes a deep maroon tone when mixed with ammonia. It is very tenacious, and is useful for many purposes.

Siemen's Cement.—Black iron rust, or iron filings, 12 lb.; sulphur, 100 lb.

Signs, Filling, Cement for.—Melt together, in a clean iron pot, 2 parts each of best asphaltum and gutta percha; stir well together, and then add 1 part of gum shellac in fine powder. It may be used hot and mixed with smalt, vermilion, or other pigment, if desired.

Slag Cement.—1.—Granulated slag is ground and mixed with lime and the mixture calcined and reground.

2.—Blast-furnace slag is mixed in the following proportions with lime and clay: Slag, 10 parts; lime, 25 parts; clay, 10 parts. Calcine.

Soft Cement.—Melt yellow beeswax

with its weight of turpentine, and color with finely powdered Venetian red. When cold it has the hardness of soap, but is easily softened, and molded with the fingers, and for sticking things together temporarily it is invaluable.

Soluble Glass Cements.—When finely pulverized chalk is stirred into a solution of soluble glass of 30° B. until the mixture is fine and plastic, a cement is obtained which will harden in between 6 and 8 hours, possessing an extraordinary durability, and alike applicable for domestic and industrial purposes. If any of the following substances be employed besides chalk, differently colored cements of the same general character are obtained:

1.—Finely pulverized or levigated stibnite (gray antimony or black sulphide of antimony) will produce a dark cement, which, after long burnishing with an agate, will present a metallic appearance.

2.—Pulverized cast-iron, a gray cement.

3.—Zinc dust, so-called zinc gray, an exceedingly hard gray cement, which, after burnishing, will exhibit the white and brilliant appearance of metallic zinc. The cement may be employed with advantage in mending ornaments and vessels of zinc, sticking alike well to metals, stone and wood.

4.—Carbonate of copper, a bright green cement.

5.—Sesquioxide of chromium, a dark green cement.

6.—Thenard's blue (cobalt blue), a blue cement.

7.—Minimum, an orange-colored cement.

8.—Vermilion, a splendid red cement.

9.—Carbon red, a violet cement.

Spirit Cement (White).—For metal, glass plates, wood, etc. (a) Bleached shellac, 1 lb.; (b) 95% alcohol, 1 qt. Dissolve (a), which should be fresh, and finely pulverized, in (b). Solution may be made cold, the operation being hastened by agitation. When dissolved, expose in an open porcelain or earthenware dish, in a dry atmosphere, until evaporated to a thick, gummy paste; or, if time be an important feature, heat some sand in an iron dish, extinguish the fire, then place the shellac mixture on the hot sand to evaporate. Do not have the sand too hot, as it might crack the dish. For a rapid setting cement, evaporate down until quite thick—*i.e.*, liquid, but not dry—then add a very little of the following mixture: Wood alcohol, 4 fl.oz. solvent naphtha (benzole), 2 fl.oz. Caution: Keep away from the fire.

Statuary.—This is simply a solution of

potassium silicate. It forms a very valuable cement for mending statuary. It suffices to brush the surfaces with the solution, and to press them firmly together.

Stephenson's Oil Cement.—1.—Litharge, 10 parts; air-slaked lime, 5 parts; fine sand, 5 parts; mix to a paste with hot linseed oil. Use immediately.

2.—Litharge, 20 parts; slaked lime, 10 parts; sand, 10 parts; linseed-oil varnish, 3 parts.

Vegetable Cement.—1.—Mix gum arabic with calcium nitrate, 1 part of the gum arabic to 10 parts of the calcium, and use 10 parts of water.

2.—Calcium nitrate, 2 parts; gum arabic, pulverized, 20 parts; water, 25 parts.

Water Cements.—1.—Slaked lime, 100 parts; brick dust, 190 parts; sand, 160 parts; blacksmith's dross, 50 parts; powdered lime, 50 parts; mix with water.

2.—Iron filings, 600 parts; ignited sand, 100 parts; powdered slaked lime, 100 parts; mix with water.

White Cement.—Mix in a well-stoppered bottle to drams of chloroform with 12½ drams of unvulcanized caoutchouc, in small pieces. The solution is easily effected, and when finished add 2½ drams of mastic, and let the whole macerate from 8 to 10 days, shaking the mixture from time to time, but without heat. A perfectly white and very adhesive cement is thus produced. This compound is made on the same principle as the cement greatly in vogue among florists for making permanent bouquets.

White Cement, Zeigler's.—Composition unknown. Is very much used on the Continent for microscopical use.

Zeiodite.—It a cement composed of 10 parts sulphur and 12 parts glue or pumice.

Zinc Ornaments, Cement for.—Water glass, having fine whiting and impure zinc (zinc gray) stirred in, forms an excellent cement, and receives a high polish.

Zinc White Cement.—German formula: 1, mastic; 2, dammar; 3, sandarac; 4, Venetian turpentine; 5, turpentine; 6, benzol; 7, zinc white. 1, 2 and 3, powdered, are mixed in a well-corked bottle with 4, 5 and 6; shake well occasionally; after several days filter, and tribu-rate in a mortar with zinc white in q. s. Dilute, if necessary, with benzol

GLUE

Glue is a cement used for joining pieces of wood together, and has for its chief constituent a substance called gelatine, obtained from the cuttings of hides, skins, tendons and other refuse parts of animals, as well as from cuttings of leather and parchment, which, after being well soaked in milk of lime, to dissolve any blood, flesh or fat, are thoroughly washed in a stream of water to remove the lime. The material is then boiled in water until the required adhesive strength is obtained, when the liquid is run off into a cistern, and clarified with powdered alum, which precipitates in the form of sulphate any lime that may remain, as well as other impurities. Before cooling it is drawn off into molds, and is then in the form of size, which, when cut into slices, and dried in the air, hardens into glue.

Hints About Glue.

1.—Good glue should be a light brown color, semi-transparent, and free from waves or cloudy lines. Glue loses much of its strength by frequent remelting; therefore, glue which is newly made is preferable to that which has been reboiled. The hotter the glue the more force it will exert in keeping the joined parts glued together. In all large and long joints it should be applied immediately after boiling. Apply pressure until it is set or hardened. Glue, being an animal substance, must be kept sweet. To do this keep it cool after it is once dissolved, and not in use. In all cases keep the glue kettle clean and sweet, by cleaning it often. Good glue requires more water than poor. The best glue will require from one-half to more than double the water that is required with poor glue, which is clear and red; the quality can be discovered by breaking a piece. If good, it will break hard and tough, and will be irregular on the broken edge. If poor, it will break comparately easy, leaving a smoothy straight edge. In dissolving glue, it is best to weigh the glue, and weigh or measure the water; otherwise, there is a liability of getting more glue than the water can properly dissolve. It is a good plan, when once the quantity of water that any sample of glue will take up has been ascertained, to put the glue and water together at least 6 hours before heat is applied, and if it is not soft enough then, let it remain longer in soak, for there is no danger in letting good glue remain in pure water, even for 48 hours. The advantage of frozen glue is that it can be made up at once, on account of its being so porous. Frozen glue of same grade is as strong as if dried. If glue is of first-rate quality, it can be used on most kinds of woodwork very thin, and will make the joint as strong as the original. White glue is made white by bleaching.

2.—The following, translated from *Des Ingenieurs Taschenbuch*, contains a great deal of valuable information, which will probably be acceptable to many of our readers. The absolute strength of a well-glued joint is:

	Pounds per square inch.	
	Across the grain, end to end.	With the grain.
Beech	2,133	1,095
Elm	1,436	1,124
Oak	1,735	568
White wood	1,493	341
Maple	1,422	896

It is customary to use from 1-6 to 1-10 of the above values, to calculate the resistance which surfaces joined with glue can permanently sustain with safety.

3.—*Cracking, To Prevent.* — a.—Glue frequently cracks because of the dryness of the air in rooms warmed by stoves. An Austrian contemporary recommends the addition of a little chloride of calcium to glue to prevent this disagreeable property of cracking. Chloride of calcium is such a deliquescent salt that it attracts enough moisture to prevent the glue from cracking. Glue thus prepared will adhere to glass, metal, etc., and can be used for putting on labels without danger of their dropping off.

b.—Add a very small quantity of glycerine to the glue. The quantity must be modified according to circumstances.

4.—*Hardening Glue.*—Try a little finely powdered brick dust, which will harden quickly in proportion to the quantity used.

Liquid Glue.

1.—Glue, cut in small pieces, 6 parts; water, 16 parts, poured over it and allowed to stand for a few hours: add sulphate of zinc, 1½ part; hydrochloric-acid gas, 1 part. Keep the mixture at a temperature of 175 to 190° F. for 10 or 12 hours. This blue may be used for joining all articles, even porcelain, glass, mother-of-pearl, etc. It does not congeal.

2.—Best white glue, 4 parts; lead carbonate, 1 part; rain water, 8 parts; alcohol, 1 part. Dissolve the glue in the water on a water bath, stirring constantly; then mix in the lead carbonate, add the alcohol, and continue the heat for a few minutes; lastly, pour into bottles while it is still hot.

3.—Take a wide-mouthed bottle, and dissolve in it 8 oz. best glue, in ½ pt.

of water, by setting it in a vessel of water and heating until dissolved. Then add, slowly, 2½ oz. of strong acquafortis (nitric acid), 36° B., stirring all the while. Effervescence takes place under generation of nitrous acid. When all the acid has been added the liquid is allowed to cool. Keep it well corked, and it will be ready for use at any moment.

4.—Take 1 pt. of the common turpentine and mix in a quart bottle with 4 fl.oz. of 98% alcohol. Agitate well, and let stand until the two fluids separate. Decant the turpentine (which will form the lower layer)from the alcohol, and mix it with 1 pt. of clear water. Agitate thoroughly, and let stand until these two fluids separate, then from the water decant the turpentine (which this time will form the upper layer), and, finally, mix with the turpentine about 1 oz. of powdered starch, and filter through paper.

5.—The following recipe is said to keep indefinitely: Best glue, 10 oz.; formaline, 40%, 1 to 3 oz.; acetic acid, 90%, 2 to 5 oz. Or, hydrochloric or nitric acid (1.3), ½ to 1½ oz.; water, 100 oz. A little glycerine increases the elasticity of the glue.

6.—Crush 100 parts of brightest gelatine as minutely as possible and pour water over it until it is entirely covered. Allow to swell for 24 hours, adding more water as the upper layer of glue dries out. Now rub up 10 parts of zinc oxide with water in a porcelain mortar to a liquid paste, and add 11 parts of concentrated hydrochloric acid; the zinc oxide will quickly dissolve. When gas ceases to be evolved, filter, and add the clear zinc solution to the glue, stirring the mixture thoroughly while pouring it in. Liquefy the glue at a beat of about 140° F. (but not over an open fire), and add 1 part of alum, previously dissolved in the minimum quantity of water. Now let the whole stand (at the same temperature) until all the impurties rise to the surface, when the transparent glue underneath is carefully decanted and admixed with 2 parts of alcohol.

7.—In a solution of borax in water soak a good quantity of glue until it has thoroughly imbibed the liquid. Pour off the surplus solution and then put on the water bath and melt the glue. Let cool down until the glue begins to set, then add, drop by drop, with agitation, enough acetic acid to check the tendency to solidification. If, after becoming quite cold, there is still a tendency to solidification, add a few drops more of the acid. The liquid should be of the consistency of ordinary mucilage at all times.

8—Dilute 1 part of official phosphoric acid with 2 parts of water, and neutralize the solution with carbonate of ammonium. Add to the liquid an equal quantity of water, warm it on a water bath, and dissolve it in sufficient glue to form a thick, syrup liquid. Keep in well-stoppered bottles.

9.—Glue or gelatine, 10 oz.; water, 40 oz.; oxalic acid, 5½ dr. Dissolve the acid in the water, and in the solution steep the glue for 24 hours; then heat on a water bath for 5 or 6 hours, dilute with water, neutralize with chalk, allow to stand until clear, and evaporate the clear solution to 20 oz.

10.—White gelatine, 40 parts; acetic acid, 40 parts; alcohol, 10 parts; alum, 2 parts. Heat the gelatine and acetic acid together on a water bath until solution takes place, add the alcohol, and the alum last.

11.—White glue, 2 oz.; acetic acid, 8 oz.; nitric acid, 10 min. Mix the glue and acetic acid in a wide-mouthed, stoppered bottle, set in a warm place, agitate frequently until dissolved, and then add the nitric acid.

12—A very good liquid glue is produced by adding to ordinary glue its volume of vinegar and the fourth of a part of alcohol. A little alum may also be added as a preservative.

13.—Glue, 100 grams; water, 150 grams; sodium salicylate, 10 grams; oil of cloves, 90 drops. Prepare by boiling in a water bath until it becomes liquid. The object of the sodium salt is to prevent setting.

14.—A German pharmaceutical chemist, named Ernest E. Eduard Martens, of Neustadt-Holstein, has patented a preparation of liquid glass for joiners, upholsterers, etc., the object being to provide a strong adhesive glue that will not be injurious to health. Dissolve ordinary glue in water, with the addition of sodium salicylate, or of one of the compounds of the derivatives of the benzol group. Place in a suitable vessel 100 parts in weight of the very best glue made from leather parings, and allow it to soften in 150 parts of water; add 10 parts in weight of sodium salicylate, and heat the mixture in a water bath until the solid part is thoroughly dissolved. To preserve the glue thus prepared, which remains liquid, add 1 gram of oil of cloves to each kgm. of glue. This solution, diluted with water, forms a cheap substitute for gum, and can be used for all household purposes. The advantages claimed for it are that it does not require to be heated for use, and is entirely free from the objectionable smell of ordinary glue.

15.—Glue, 1 oz.; acetic acid, 11 oz.; carbolic acid, 10 min.; water, sufficient. Macerate the glue in 6 fl.oz. of water for 12 hours, heat the mixture on a water bath until the glue is dissolved, add the acids, and finally enough water to make 1 pt.

16.—Dissolve 3 parts of glue, in small pieces, in 12 to 15 parts of saccharate of lime. By heating the glue dissolves rapidly, and remains liquid, when cold, without loss of adhesive power. Any desirable consistency can be secured by varying the amount of saccharate of lime. Thick glue retains its muddy color, while a thin solution becomes clear on standing. The saccharate of lime is prepared by dissolving 1 part of sugar in 3 parts of water; add ¼ part of the weight of the sugar of slaked lime, heat the whole to 65 to 85° C., allow it to macerate for several days, and shake it frequently. The solution, which has the properties of mucilage, is then decanted from the sediment.

17.—Glue, 8 oz.; glacial acetic acid, 1 oz.; water sufficient to make 16 oz. Soak the glue in enough water to cover it, until soft, then heat on a water bath until dissolved; add the acetic acid, and sufficient water to make up the measure of 16 oz., and strain.

18.—White glue, 12 av.oz.; alum, 50 gr.; acetic acid, 1 fl.oz.; water, 13 fl.oz.; alcohol, 3 fl.oz. Mix all but the alcohol, digest on a water bath until the glue is dissolved. When cool add the alcohol.

19.—Isinglass, 1 oz.; mastic, ½ oz.; alcohol, 1½ oz.; water, 6 oz. Soak the isinglass in a portion of the water until soft, then add the balance of the water, and heat until dissolved; to this add the mastic, dissolved in the alcohol.

20.—To make 1 gal. of the gum, about 1½ gal. of water, 3 lb. of glue, 4 oz. of borax, and 2 oz. of carbonate of soda, or an equivalent of any other alkali, are taken. The glue and alkaline salts are dissolved in the water by heat, and the solution is kept at a temperature a few degrees below boiling point for 5 or 6 hours. The continued application of heat renders the gum permanently liquid at the ordinary temperature. After allowing the sediment to settle, the clear liquid is evaporated to the required consistency.

21.—Soak gelatine in water, melt at a low heat, and add strong vinegar or acetic acid until it remains liquid when cold.

22.—*Brand's Liquid Glue.*—Borax, 60 kgm.; water, 100 l.; solution of potassa, 90% 4 kgm.; solution of glue, 12° B., 1,450 kgm. Dissolve the borax in the water, add to the boiling solution of potassa, and to this add the hot solution of glue.

23.—*Quick-Setting Glue Cements.*—For paper, cloth, leather, wood, earthenware, etc.: (a) Soak 1 lb. of white fish glue 4 hours in 30 fl.oz. of cold water; (b) mix 4 oz. of dry white lead with 2 fl.oz. of hot water; (c) 4 oz. 90% alcohol. Dissolve (a) by aid of a glue pot, then slowly add (b). Cook for about 10 minutes, then let cool to about 100° F. Now, with constant stirring, add (c). This cement sets in about 1 minute, due to the alcohol used. It is non-elastic, and extremely hard. For leather and cloth, if wanted pliable, add 2 to 4 oz. of glycerine, according to the elasticity desired. The above cement, without glycerine, and with the addition of 4 oz. of red lead, will stand a bath in hot oil without frying out.

24.—*Russian Liquid Glue.*—Soften 50 parts of best Russian glue in 50 parts of warm water; add, slowly, from 2¾ to 3 parts of aquafortis and 3 parts or powdered sulphate of lead.

25.—*Spaulding's Glue.*—Soak the glue in cold water, using only glass, earthen or porcelain dishes. Then by gentle heat dissolve the glue in the same water, and pour in a small quantity of nitric acid, sufficient to give the glue a sour taste, like vinegar, about 1 oz. to every pound of glue.

26.—*Syndeticon—Liquid Fish Glue.*—Fish glue, 100 parts; acetic acid, 125 parts; gelatine, 20 parts; water, 125 parts; shellac varnish, 20 parts. Dissolve the fish glue in the acid, the gelatine in the water, mix the solutions, and the gradually incorporate the varnish.

27.—*Very Strong Liquid Glue.*—Glue 4½ parts; water, 12 parts. Let them stand several hours. To soften the glue, add muriatic acid, ¾ part; sulphate of zinc, 1⅛ parts. Heat the mixture to 185° F. for 10 or 12 hours. This glue remains liquid after cooling. Used for sticking wood, crockery and glass.

Special Glues.

1.—*Chromium Glue.*—a.—Glue, when combined with chromates, and exposed to light, loses its solubility in water, and can, therefore, be used as a cement for articles exposed to moisture. The following is a suitable formula: White glue, 5 to 20 parts; water, 20 parts; potassium bichromate, 1 to 2 parts; water, 10 parts. Make solutions of the glue and potassium bichromate in separate portions of water, as indicated above (the glue being dissolved by heat); stir in the solution of bichromate; mix well, and then pour the mixture into tin boxes and allow it to congeal therein. For use, take a sufficient quantity of the glue, melt in a cup standing in boiling water; place a layer uniformly on the fractured surfaces, press them together, and expose the articles to the sun for a few hours

b.—Chrome glue is known to consist of a moderately strong gelatine solution (containing 5 to 10% of gelatine), to which about 1 part of acid chromate of potassium, in solution, is added to every 5 parts of gelatine. This mixture possesses the property of becoming insoluble by water through the action of sunlight under partial reduction of the chromic acid, a property which is advantageously utilized in photography. The author coated both fractures of a glass as uniformly as possible with the freshly prepared solution, pressed them together, and fixed them in this position with a cord. The cylinder glass was exposed to the sunlight, and was found to be firmly united after a few hours. Even hot water did not dissolve the oxidized chrome glue, and the fracture was scarcely noticeable. Valuable articles of glass, which would be disfigured by a thick cement joint, can be very nicely repaired in this manner. In the production of waterproof textures chrome glue is likewise of use; at least, where a certain tightness is no drawback. The fabric, after having been put in a frame, only needs to be painted 1 to 3 times with the hot chrome glue, and then to be exposed to the sunlight or daylight. Used specially as a glass cement.

2.—*Compound Glue.*—Take very fine flour, mix it with white of eggs, isinglass and a little yeast; mingle the materials, and beat them welll together; spread them, the batter being made thin with gum water, on even tin plates, and dry them in a stove; then cut them out for use. To color them, tinge the paste with Brazil or vermilion for red; indigo or verditer, etc., for blue; saffron, turmeric or gamboge, etc., for yellow.

3.—*Elastic Glue.*—a.—Best glue, 7 av.oz.; glycerine, 16 fl.oz.; water, enough. Pour on the glue more than enough water to cover, allow to macerate for several hours, then decant the greater portion of water; apply heat until the glue is dissolved, and add the glycerine. If the mixture is too thick, more water may be added. It may be colored by means of an aniline dye, dissolved in alcohol. The addition of a little calcium chloride also tends to prevent the glue from cracking. May be used for camera bellows.

b.—The following does not spoil: Dissolve good common glue in water, on the water bath, and evaporate the water down to a mass of thick consistency; add a quantity of glycerine equal in weight with the glue, after which continue the heating until all the water has been driven off; pour the mass out into molds or on a marble slab. This mixture answers for stamps, printer's rolls, galvano-plastic copies, etc.

4.—*Ether Glue.*—Dissolve glue in nitric ether. The ether will only dissolve a certain amount of glue, therefore the solution cannot be made very thick; it will be about the consistency of molasses, and is much more tenancious than glue made with hot water. It is improved by adding a few bits of India rubber, cut into pieces about the size of a buckshot. Let the solution stand a few days, stirring frequently.

5.—*Fireproof Glue.*—Mix a handful of quicklime in 4 oz. of linseed oil, boil to a good thickness, then spread on tin plates in the shade, and it will become exceedingly hard, but may be easily dissolved over the fire, and used as ordinary glue.

6.—*Frozen Glue.*—The glue, while gelatinous, is sliced, placed on nets, and allowed to freeze by natural cold. Of course, the process can only be conducted in cold weather. The product is porous, and much more bulky than hard glue, but is a better article, as it dissolves more easily. It sells largely in New England, where it is preferred by buyers to the hard glue.

7.—*Isinglass Glue.*—Dissolve isinglass in water, and strain it through coarse linen. Then add a little alcohol, and evaporate to such a consistency that when cold it will be dry and hard. This will be found to be more tenancious than common glue, and therefore preferable in many cases.

8.—*Marine Glue.*—a.—Although now far from new, the extremely valuable marine glue of Jeffrey does not seem to be as well known in this country as it deserves. Prepared by dissolving 1 part of India rubber in crude benzine, and mixing with 2 parts of shellac, by the aid of heat. The waterproof character of this cement, in connection with its slight elastic flexibility, the ease with which it is applied when warm, and the promptness with which it sets, on cooling, make it a most useful substance in many applications to house construction and furniture, as well as on board ship, where it was originally intended to be chiefly employed.

b.—Caoutchouc, 1 oz.; genuine asphaltum, 2 oz.; benzole or naphtha, q. s. The caoutchouc is first dissolved by digestion and occasional agitation, and the asphaltum is gradually added. The solution should have about the consistency of molasses.

c.—Take of coal naphtha, 1 pt.; pure (not vulcanized) rubber, 1 oz.; cut in shreds, and macerate for 10 or 12 days, and then rub smooth with a spatula on a slab; add, at heat enough to melt, 2 parts of shellac, by weight, to 1 part of this solution. To use it, melt it at a temperature of about 248° F.

d.—Elastic Marine Glue.—Dissolve unvulcanized rubber in chloroform, benzole, or bisulphide of carbon. Ropes, or other material exposed to the action of air and water, are coated with this glue. Whiting or fine sand may be added.

9.—*Parchment Glue.*—Parchment, 10 parts, is cut into small pieces, and boiled in 128 parts of water until the liquid is reduced to 80 parts. The decoction is filtered through linen, and evaporated over a gentle fire until it presents the required consistency.

10. — *Powdered Glue, Soluble Cold.*— Carbonate of potash, 1 part; alum, 1½ parts; ordinary glue or fish glue, 10 parts: water, 4 parts. The whole is mixed and boiled, dried by ordinary methods, and then pulverized. It is appicable to any use.

11.—*Rubber Glue.*—Take 1 lb. of glue, cover it with cold water in a vessel in which it can be heated, let it stand overnight; then add 1 fl.oz. of glycerine, and apply heat; bring to the boiling point, and continue the boiling for about 15 minutes; take off the fire and add to it coloring matter, if desired, and pour into molds, from which remove when it has become rigid. Keep in a cool place; when used, apply gentle heat to soften, being careful never to bring to a boil.

12.—*Stratena.*—This well-known household cement is said to be prepared as follows: White glue, 6 parts, dissolved in 8 parts of acetic acid; this solution is added to another composed of 1 part of French gelatine in 8 parts of water. After mixing add 1 part of shellac varnish.

13.—*Tungstic Glue.*—Tungstic glue has been suggested as a substitute for hard India rubber, as it can be used for all the purposes to which the latter is applicable It is thus prepared: Mix a thick solution of glue with tungstate of soda and hydrochloric acid. A compound of tungstic acid and glue is precipitated, which, at a temperature of 86 to 104° F., is sufficiently elastic to be drawn out into very thin sheets.

14.—*Veneering Glue, Well Suited for Inlaying.*—The best glue is readily known by its transparency, and being of a rather light brown, free from clouds and streaks. Dissolve this in water, and to every pint add ½ gill of the best vinegar and ½ oz. of isinglass.

15.—*White Glue.*—A writer in the *Moniteur Scientifique* says that to add oxalic acid and white oxide of zinc, in the proportion of 1%, to glue, gives a whiter and clearer product than any of the measures now in use. The glue should first be reduced with water, and heated to a thick syrup, and the chemicals added while the mass is hot.

LUTES*

BY SAMUEL S. SADTLER

The subject of plastic cements used to secure joints in vessels and connections (generally for temporary purposes) has been rather neglected in the chemical literature.

The success or failure of processes has very seldom depended upon the choice of satisfactory lutes, but great annoyance has been experienced in chemical works and manufacturing places where only unsuitable compounds have been found to seal apertures in nitric acid, chlorine, hydrogen-sulphide and illuminating-gas apparatus, and frequently considerable damage to property and loss of life has resulted.

The majority of these cements are useful for purposes of preventing the escape of inert gases, and others are suitable for more or less special purposes, where corrosive gases, etc., come in contact with them. Many of them had to be put down from memory, and therefore the product obtained in their use may be a little too stiff or too thin, but such deficiencies could be easily regulated.

Lutes always consist of a menstruum and dissolved or suspended solids, and they must not be attacked by the gases and liquids coming in contact with them. In some cases the constituents of the lute react to form a more strongly adhering mass.

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The conditions of application are, in brief:

(a) Heating the composition to make it plastic until firmly fixed in place.

(b) Heating the surfaces.

(c) Applying the lute with water or a volatile solvent, which is allowed to volatilize.

(d) Moistening the surface with water, oil, etc. (the menstruum of the lute itself).

(e) Applying the lute in workable condition, and the setting taking place by chemical reactions.

(f) Setting by hydration.

(g) Setting by oxidation.

These principles will be found to cover nearly all cases.

Joints should not be ill-fitting, depending upon the lute to do what the pipes or other parts of the apparatus should do. In most cases, one part of the fitting should overlap the other, so as to make a small amount of the lute effective, and to keep the parts of the apparatus rigid, as a luted joint is not supposed to be a particularly strong one, but rather one quickly applied, effective while in place, and easily removed.

Very moderate amounts of the lute should be used, as large amounts are likely to develop cracks, be rubbed off, etc.

A classification may be given as follows:

(1) Plaster of paris.
(2) Hydraulic cement.
(3) Clay.
(4) Lime.
(5) Asphalt and pitch.
(6) Rosin.
(7) Rubber.
(8) Linseed oil.
(9) Sasein and albumen.
(10) Silicates of soda and oxychloride cements.
(11) Flour and starch.
(12) Miscellaneous, including core compounds.

I. PLASTER OF PARIS

is, of course, often used alone, as a paste, which quickly solidifies, for gas and wood distillation retorts, etc., and similar places where quickness of setting is requisite. It is more often, however, used with some fibrous material to give it greater strength. Asbestos is the most commonly used material of these, as it will stand a high temperature. When that is not so important, straw, plush trimmings, hair etc., are used as binders, while broken stone, glass and various mineral substances are used as fillers; but they do not add anything to the strength. These lutes seem to be particularly suitable for oil vapors and hydrocarbon gases:

Formulae: 1, plaster and water; 2, wet plaster and asbestos; 3, wet plaster and straw; 4, wet plaster and plush trimmings; 5, wet plaster and hair; 6, wet plaster and broken stone, etc.

II. HYDRAULIC CEMENT

Cement is used either alone or with sand, asbestos, etc., and it is said that these lutes are suitable for nitric acid. When used with substances such as rosin or sulphur, it is probably employed because it is in such a fine state of division, and used as a filler, and not because of any powers of setting by hydration.

Formulae: 1, neat cement; 2, cement and asbestos: 3, cement and sand.

III. CLAY

This must frequently enters into the composition of lutes as a filler, but even then the very finely divided condition of certain grades renders it valuable, as it gives body to a liquid such as linseed oil, which, unless stiffened, would be previous to a gas, the clay, in all cases, being neutral. Thus, for luting pipes carrying chlorine, a stiff paste of clay and molasses has been suggested by Theo. Koller in *Die Surrogate*, but is cannot be recommended, as it soon gives way.

Formulae: 1, clay and linseed oil; 2, same, using fireclay; 3, clay and molasses. 1 is suitable for steam, etc.; 2, for chlorine, and 3 for oil vapors.

IV. LIME

is used in the old lute known as putty, which consists of caustic lime and linseed oil. Frequently the lime is replaced by chalk and china clay, but the lime should be, in part, at least, caustic, so as to form a certain amount of lime soap. Lime is also used in silicate and casein composition, which are very strong and useful.

Formulae: 1, lime and boiled oil to stiff mass; 2, clay, etc., boiled oil to stiff mass.

V. ASPHALT AND PITCH

These substances are used in lutes somewhat interchangeably. As a rule, pitch makes the stronger lutes. Tar is sometimes used, but because of the light oils and (frequently) water contained, it is not as good as either of the others.

Asphalt, dissolved in benzol, is very useful for uniting glass for photographic.

microscopical and other uses; also for coating wood, concrete, etc., where the melted asphalt would be too thick to cover well. Benzol is the cheapest solvent that is satisfactory for this purpose, as the only one that is cheaper would be a petroleum naphtha, and it does not dissolve all the constituents of the asphalt. For waterproofing wood, brick, concrete, etc., melted asphalt alone is much used, but when a little paraffine is added it improves its waterproofing qualities, and in particular cases boiled oil is also added to advantage. Formulae:

1.—Refined lake asphalt.

2.—Asphalt, 4 parts; paraffine, 1 part.

3.—Asphalt, 10 parts; paraffine, 2 parts; boiled oil, 1 part.

Any of these may be thinned with hot benzol or toluol. Toluol is less volatile than benzol, and about as cheap, if not cheaper, the straw-colored grades being about 24 cents per gallon.

Examples of so-called "stone cement" are:

4.—Pitch, 8 parts; rosin, 6 parts; wax, 1 part; plaster, ¼ to ½ part.

5.—Pitch, 8 parts; rosin, 7 parts; sulphur, 2 parts; stone powder, 1 part.

These compositions are used to unite slate slabs and stoneware for domestic, engineering and chemical purposes. Various rosin and pitch mixtures are used for these purposes, and the proportions of these two ingredients are determined by the consistency desired. Sulphur and stone powder are added to prevent the formation of cracks, sulphur acting chemically and stone powder mechanically. Where the lute would come in contact with acid, or vapors of the same, limestone should not be the powder used; otherwise, it is about the best. Wax is a useful ingredient to keep the composition from getting brittle with age.

A class of lutes under this general grouping that are much used are so-called "marine glues." They must be tough and elastic. When used for calking on a vessel, they must expand and contract with the temperature, and not crack or come loose. Formulae:

6.—Pitch, 3 parts; shellac, 2 parts; pure crude rubber, 1 part.

7.—Pitch, 1 part; shellac, 1 part; rubber substitute, 1 part These are used by melting over a burner.

VI. ROSIN, SHELLAC AND WAX

A strong cement, used as a stone cement, is:

1.—Rosin, 8 parts; wax, 1 part; turpentine, 1 part. It has little or no body, and is used in thin layers.

For nitric and hydrochloric acid vapors:

2.—Rosin, 1 part; sulphur, 1 part; fireclay, 2 parts. Sulphur gives great hardness and permanency to rosin lutes, but this composition is somewhat brittle.

Good waterproof lutes of this class are:

3.—Rosin, 1 part; wax, 1 part; powdered stone, 2 parts.

4.—Shellac, 5 parts; wax, 1 part; turpentine, 1 part; chalk, etc., 8 to 10 parts.

For a soft, airtight paste for ground-glass surfaces:

5.—Wax, 1 part; vaseline, 1 part.

6.—A strong cement, without body, for metals (other than copper, or alloys of same), porcelain and glass, is made by letting 1 part of finely powdered shellac stand with 10 parts of ammonia water until solution is effected.

VII. RUBBER

Because of its toughness, elasticity, and resistance to alterative influences, rubber is a very useful constituent in lutes, but its price makes its use very limited.

1.—Leather cement. Asphalt, 1 part; rosin, 1 part; gutta percha, 4 parts; carbon bisulphide, 20 parts.

2.—To stand acid vapors. Rubber, 1 part; linseed oil, 2 parts; fireclay, 3 parts.

3.—Plain rubber cement. Cut the crude rubber in small pieces and then add the solvent. Carbon bisulphide is the best; benzol, good, and much cheaper; but gasoline is probably most extensively used because of its cheapness.

4.—To make corks and wood impervious to steam and water, soak them in a rubber solution as above; if it is desired to protect them from oil vapors, use glue composition. (See Section IX.)

VIII. LINSEED OIL

This is one of the most generally useful substances we have for luting purposes, if absorbed by a porous substance that is inert. Formulae:

1.—China clay of general utility for aqueous vapors; linseed oil of general utility for aqueous vapors.

2.—Lime forming the well-known putty; linseed oil forming the well-known putty.

3.—Red or white lead and linseed oil.

These mixtures become very strong when set, and are best diluted with powdered glass, clay or graphite. These are almost an endless number of lutes using metallic oxides and linseed oil. A very good one, not getting as hard as those containing lead, is:

4.—Oxide of iron and linseed oil.

IX. CASEIN ALBUMEN AND GLUE

These, if properly made, become very tough and tenacious; they stand moderate heat and oil vapors, but not acid vapors.

1.—Finely powdered casein, 12 parts; slaked lime, fresh, 50 parts; fine sand, 50 parts; water to thick mush.

A very strong cement for ground unions stands moderate heat, as follows:

2.—Casein, in very fine powder, 1 part; rubbed up with silicate of soda, 3 parts.

A strong lute for general purposes, which must be used promptly when made:

3.—White of egg, made into a paste with slaked lime.

A composition for soaking corks, wood, packing, etc., to render them impervious to oil vapors, is:

4.—Gelatine or good glue, 2 parts; glycerine, ½ to 1 part; water, 6 parts. Oil of wintergreen, etc., to keep from spoiling.

X. SILICATE AND OXYCHLORIDE CEMENTS

1.—For oil vapors, standing the highest heat: A stiff paste of silicate of soda and asbestos.

2.—Gaskets for superheated steam, retorts, furnaces, etc.; Silicate of soda and powdered glass: dry the mixture, and heat. Not as strong, however, as the following:

3.—Silicate of soda, 50 parts; asbestos, 15 parts; slaked lime, 10 parts.

4.—Metal cement. Silicate of soda, 1 part; oxides of metal, such as zinc oxide, litharge, iron oxide, singly or mixed, 1 part.

5.—Very hard and extra strong composition. Zinc oxide, 2 parts; zinc chloride, 1 part; water to make a paste.

6.—Very hard and extra strong composition. Magnesium oxide, 2 parts; magnesium chloride, 1 part; water to make a paste.

XI. FLOUR AND STARCH COMPOSITIONS

1.—The well-known flaxseed poultice sets very tough, but does not stand water or condensed steam.

2.—Flour and molasses, made by making a stiff composition of the two. This is an excellent lute to have at hand at all times for emergency use, etc.

3.—Stiff paste of flour and strong zinc chloride solution forms a more impervious lute, and is more permanent as a cement. This is good for most purposes, at ordinary temperature, where it would not be in contact with nitric-acid vapors or condensing steam.

4.—A mixture of dextrine and fine sand makes a good composition, mainly used as core compound.

XII. MISCELLANEOUS

1.—Litharge and glycerine, mixed to form a stiff paste; sets and becomes very hard and strong, and is very useful for inserting glass tubes, etc., in iron or brass.

2.—For a high heat. Alumina, 1 part; sand, 4 parts; slaked lime, 1 part; borax, ½ part; water, sufficient.

Of course, there are an almost infinite number of lutes or cements, but, classified as these are, they represent the largest number of them. A class of mixtures that can only be classified according to their intended use are core compounds.

1.—Dextrine, about 1 part; sand, about 10 parts; with enough water to form a paste.

2.—Powdered anthracite coal, with enough molasses to form a stiff paste.

3.—Rosin, partly saponified by soda lye, 1 part; flour, 2 parts; sand, with sufficient water, 4 parts. These proportions are approximate, and the amount of sand can be increased for some purposes.

4.—Glue, powdered, 1 part; flour, 4 parts; sand, with sufficient water, 6 parts. mixture is used. It does not seem to be a gasket or a core compound: Oats (or wheat), ground, 25 parts; glue, powdered, 6 parts; sal ammoniac, 1 part.

Glass, Lute for.—As a coating for glass vessels, to protect them from injury during exposure to the fire, pipeclay and horse dung are made into a paste with water. This composition is applied by spreading it on paper. Shredded tow or plumbago is substituted for the horse dung.

Retorts, Lute for.—1.—Lemery, the chemist, used the following lute for stopping retorts, etc.: Fine flour and fine lime, of each 1 oz.; potter's earth, ¼ oz.; make a moist paste of these with white of egg, well beaten up with a little water, and this will be found to stop exceedingly close.

2.—This cement is used also in melting pots. Sift brick dust, and mix with equal quantity red lead; rub together with boiled linseed oil, which is mixed with coarse sand to the stiffness of cement. In covering dishes, apply the paste, then said. Heat for a long time.

3.—Rub freshly slaked lime into a concentrated solution of borax; apply with a stiff brush, and allow it to dry. When heated, the glazing fuses.

4.—For large pots, take litharge, 6 parts; fresh burnt pulverized lime, 4 parts; white bole, 2 parts; mix with cold linseed oil.

5.—*Boyle's.*—Pound in a mortar some fine quicklime and scrapings of cheese; water, q. s. to make a soft paste. Spread on a linen rag, and apply.

MUCILAGES

1.—The best quality of mucilage in the market is made by dissolving clear glue in equal volumes of water and strong vinegar, and adding one-fourth of an equal volume of alcohol, and a small quantity of a solution of alum in water. The action of the vinegar is due to the acetic acid which is contains. This prevents the glue from gelatinizing by cooling; but the same result may be accomplished by adding a small quantity of nitric acid. Some of the preparations offered for sale are merely boiled starch or flour mixed with nitric acid to prevent the gelatinizing.

2.—A strong aqueous solution of reasonably pure dextrine (British gum) forms a most adhesive and cheap mucilage. Alcohol is usually employed as the solvent where the mucilage is to be used for gumming envelopes, postage stamps, etc., in order to facilitate the drying, and acetic acid is added to increase the mobility of the fluid. The strong aqueous solution is more adhesive than that prepared with alcohol, for the reason that it contains a greater proportion of the gum. To prepare this, add an excess of powdered dextrine to boiling water, stir for a moment or two, allow to cool and settle, and strain the liquid through a fine cloth. The addition of a little powdered sugar increases the glossiness of the dried gum without interfering greatly with its adhesiveness. The sugar should be dissolved in the water before the dexture is added.

3.—Add British gum (dextrine) to a quantity of hot water until a syrupy liquid is obtained; then add a few drops of clove oil, and cool for use.

4.—Dieterich (*Pharm. Centralhalle*) recommends the following as equal to any gum arabic mucilage: Dextrine, 400 parts, stirred in 400 parts of water, diluted with 200 parts more of water; 20 parts of glucose and 10 parts of aluminum sulphate are added, and the mixture heated to about 195° F., when the mass will become transparent and thin.

5.—Brown dextrine, 1 lb.; acetic acid, 4 oz.; alcohol, 4 oz.; water, q. s. ad 2 pt. Dissolve the dextrine in 1 pt. of boiling water, strain through Canton flannel; add the acetic acid, and when nearly cold add the alcohol, stirring thoroughly.

6.—Dextrine, 10 drams: glucose, ½ dram; in which is dissolved a solution of alum, 15 gr.; glycerine, 1 dr.; water, to make 2 oz.

7.—White dextrine, 6 oz.; dilute acetic acid, 1 oz.; oil of cloves, 10 drops; glycerine, 1 oz.; water, to make 16 oz. Mix the dextrine thoroughly with 6 oz. of cold water, add 8 oz. of boiling water, boil 5 minutes, stirring constantly; add hot water sufficient to make 14 oz. When it is cold add the acetic acid, oil of cloves and glycerine. The oil must be thoroughly mixed with the remainder.

8.—Powdered sugar, 1 part; sodium silicate solution, 4 parts; mix, and warm until dissolved.

9.—Dextrine, 50 to 90 parts; alum, 4 parts; sugar, 75 parts; water, 120 parts; 10% carbolic acid solution, 60 parts. Mix.

10.—Yellow dextrine, 4 oz.; soft or distilled water, 6 fl.oz. Dissolve cold, as heat destroys the adhesive properties of dextrine. If a more fluid gum is desired, use 8 fl.oz. of water.

Carragheen, Adhesive.

(According to J. Besele.) Soak 60 parts of carragheen moss in 1,200 parts of water, then boil. To the carragheen decoction add 6 parts potassium carbonate, and concentrate the fluid by evaporation until a sample drop on glass remains attached, suspended, on cooling. Filter the fluid through a cloth or sieve, and to the filtrate add 5,000 parts of warmed water glass, of 38 to 40° B., constantly stirring. To the mixture thus obtained add 2,500 parts of rock candy, moistened with water. As soon as the candy has dissolved, still further concentrate the mixture, if necessary, until it is ropy; then remove from the fire and thoroughly mix with 75 parts of glycerine.

Dextrine.

British or starch gum. A soluble substance, recembling gum, formed by the action of dilute acids at the boiling temperature, and by infusion of malt at about 160° F. on starch. It is also formed when potato starch is heated to 400° F. Used extensively in the manufacture of mucilages, etc. It resembles gum. Its name is derived from the action of its solution on polarized light; it causes the plane of polarization to deviate to the right. Commercial dextrine, or "British gum," is obtained by heating dry potato starch to a temperature of 750° F. in sheet-iron trays or revolving iron or copper drums, similar to those used in coffee roasting, whereby it is transformed into semi-transparent, brownish lumps, which are converted into a pale yellow powder by grinding between millstones. It is completely soluble in cold water, from which it may be precipitated by addition of excess of strong alcohol. Potato starch is generally used, but starch from other sources will answer. The best tests to ascertain its purity are to agitate briskly a few grains of the dextrine in a test tube with 50 times its weight of pure cold water; then set it aside for 10 minutes. Pure dextrine dissolves completely in cold water to a clear solution. If not all dissolved, pour off the solution, add a little water to the residue, heat to boiling, let cool, and add a few drops of iodine water; a blue color indicates starch.

Gelatine Mixture, Adhesive.

Gelatine is commonly used as a basis for such preparations; its solubility is increased by the addition of sugar; and isinglass (which is another variety of the same substance) is also employed, both alone and in admixture with gelatine. Brown sugar and molasses, in proper proportions, are said to answer better in these mixtures than white sugar.

1.—Gelatine and sugar, equal parts; water, a sufficient quantity. Dissolve the gelatine in the water, in a water bath, add the sugar, and continue the heat until the mass is reduced to such a consistency that it will solidify on cooling, and cast into suitable molds, or pour on a slab and cut up into cakes.

2.—Gelatine, 4 oz.; isinglass, 1 oz.; sugar, 1 oz.; water, a sufficient quantity. Proceed as in 1.

3.—Gelatine, 1 oz.; isinglass, 1 oz.; sugar, ¼ oz.; tragacanth, ¼ oz.; water, a sufficient quantity. Proceed as in 1. Solution of the gelatine is most readily effected by allowing it to soak in cold water until it becomes softened, pouring off the superfluous water, and then applying heat.

Gum Arabic Mucilage.

1.—To make a clear, almost odorless and permanent mucilage, Francke neutralizes the free acid present in the gum with lime water. Instead of water he uses a mixture of 20% lime water and 80% distilled water.

2.—Ordinary mucilage, made from gum arabic, does not fix paper to wood or pasteboard, or to metallic surfaces. These disadvantages are overcome by adding a solution of sulphate of aluminum, made up in 10 times its quantity of water; 10 gr. of aluminum sulphate are sufficient for 250 gr. of mucilage. Prepared in this way, it will not become moldy. Again, according to Hirschberg, a few drops of strong sulphuric acid are added to the gum solution, and the precipitated sulphate of lime allowed to settle. Solutions prepared in this way a year and a half ago have neither become moldy nor lost their adhesive power.

3.—*Gum, To Preserve.*—a.—Hirschberg adds a few drops of sulphuric acid, whereby the lime contained in the gum is precipitated as sulphate; after standing, the mucilage is strained off, and exhibits no tendency to moldiness, even after standing for 18 months.—*Les Mondes.*

b.—Moisten the gum with alcohol, then dissolve in water and add a few drops of sulphuric acid. After the deposition of the precipitated calcic sulphate, a perfectly colorless solution of gum is obtained, even when inferior kinds of gum are used.

c.—To preserve gum solutions, a few drops of oil of cloves, alcohol or acid will preserve a quart of the mucilage of gum arabic or gum tragacanth from turning sour. A small quantity of dissolve alum will preserve flour paste.

4.—Gum arabic, 100 parts; water, 140 parts; glycerine, 10 parts; acetic acid dilute, 20 parts; aluminum sulphate, 6 parts. Dissolve the gum in the water and add the glycerine. Afterward add the acetic acid and the aluminum sulphate, and mix thoroughly. Let stand a while, then pour through a hair sieve. This mucilage is very strong partaking somewhat of the qualities of glue or gelatine solutions.

5.—Best glue, 50 parts; water, sufficient. Cover the glue, broken into small pieces, with cold water, and let macerate overnight. In the morning throw the glue on a towel and strain off the residual water. Dissolve 100 parts of powdered rock candy (loaf sugar will answer) and 25 parts of powdered gum arabic in 200 parts of water, by the aid of heat, in the water bath. When completely dissolved, add the swollen glue, continue the heat until it is dissolved, and when this occurs pour off into suitable receptacles.

6.—Gum arabic, 4 parts; water, 8

parts; glycerine, 1 part; neutral spirit, 3 parts. Mix.

7.—Gum arabic, 70 parts; water, 200 parts; aluminum sulphate, 2 parts. Dissolve the alminum sulphate in a small portion of the water and the gum arabic in the rest, and mix the solutions.

8.—Gum arabic, 34 oz.; water, 66 oz.; hydronaphthol, 30 gr. Place the gum and hydronaphthol in a cloth bag, and the same in a crock containing the water.

9.—*Elastic Mucilage.*—Glycerine, 4½ parts; soft soap, 4½ parts; salicylic acid, 1½ parts, dissolved in 30 parts of alcohol. Shake thoroughly, and add to a mucilage made of 139½ parts of gum arabic and about 270 parts of water. This mucilage remains elastic when dried, and does not have a tendency to crack.

10.—*Household Mucilage.*—(a) Pulverized gum arabic, 3 oz.; white sugar, 1 oz.; boiling water, 5 fl.oz. (b) White wine vinegar, 1 fl.oz. (or ¼ oz. of acetic acid with ¾ oz. of water). Mix (a) with (b). The acid is added to the gum in order to make it take hold of metal.

Linseed Mucilage.

Linseed, 1 oz.; warm water, 6 oz. Digest for 6 hours, stir, and then strain.

Stick Mucilage and Glue.

Mucilage in the form of sticks is much used in architectural and mechanical drawing for attaching the drawing paper to a board, and is generally spoken of as mouth or lip glue. In making such a glue only a very pure form of gelatine or glue should be used, as the least odor would prove disgusting when the glue is moistened with the lips. Sugar is generally added, not for the purpose of sweetening the glue, but in order to render it more easily soluble when it is to be used. This probably is brought about by the sugar preventing the glue from becoming too dry and hard. Some even use a good quality of glue without any admixture whatever, but this requires more rubbing when it is applied, although it holds better than that to which sugar has been added.

1.—The following formula is from Haldane, who states that brown sugar, or even molasses, is better than pure crystallized sugar for use in preparing his glue: Best glue, 4 oz.; isinglass, 1 oz.; brown sugar, 1 oz.; water, q. s. Soak the glue and isinglass in water until soft. Pour off the superfluous water and add the sugar. Melt the whole together with a gentle heat, and allow to evaporate until quite thick. Pour into a flat-bottomed dish that is quite cold, preferably placed on ice, and when solid cut the glue into the desired shape.

2.—Dissolve 1 lb. of fine glue or gelatine in water, evaporate it till most of the water is expelled, add ½ lb. of brown sugar, and pour it into molds. Some add a little lemon juice. It is also made with 2 parts of dextrine, 2 parts of water and 1 part of spirit.

3.—Dissolve 100 parts of white gelatine and 50 parts of crystallized sugar in 150 parts of distilled water by aid of the water bath, and continue the operation until the product measures 200 parts, when it can be formed into sticks.

4.—Glue, 12 parts; sugar, 5 parts. Boil the glue until entirely dissolved, dissolve the sugar in the hot glue, and evaporate the mass until it hardens on cooling. The hard substance dissolves rapidly in lukewarm water, and is an excellent glue for use on paper.

5.—Dissolve gum arabic in hot water to form a syrupy liquid, add a little clove oil, and thicken with powdered gum dextrine; mold, and dry slowly.

Tragacanth Mucilage.

1.—(a) Pulverized tragacanth, 1 oz.; glycerine, 4 fl.oz. (b) Boiling water, 16 fl.oz. Macerate the tragacanth with the glycerine in a glass mortar, then stir the paste into the boiling water. This makes a very thick mucilage; 32 fl.oz. of boiling water gives a medium, and 64 fl.oz. a thin paste. Tragacanth paste works very smooth, but is not very adhesive.

2.—Tragacanth, 1 av.oz.; gum arabic, 1 av.oz.; boiling water, 64 fl.oz.; carbolic acid, 1 fl.dr.

PASTES

A peculiar property of dextrine has been brought to light, it seems, by Mr. F. Edel, which is that when dissolved in water in a certain ratio, and at a limited temperature, it will yield a gelatinous paste instead of a mucilage. This fact was ascertained after considerable experimenting and reference to the patent on a certain well-known commercial brand of paste denominated "library paste," and when is considered one exceedingly well adapted for mounting photographs. The writer, who describes his experiments in a paper published in the *American Druggist*, maintains that neither flour, starch, nor gelatine pastes, nor those containing both starch and gelatine, are suitable as mounting agents, owing either to their tendency to strike through thin paper, or to the lack of adhesiveness. This difficulty appears to have been overcome by several manufacturers in their pastes advertised to photographers, and Mr. Edel has solved the riddle. Aside from correct proportions, two things have to be observed: not all kinds of dextrine are suitable, and the best white makes must be experimented with, and the temperature at which solution is effected must not exceed 160° F. The following provisional formula is presented, which, however, may possibly bear improvement; at least, more of the volatile oils may be required, which are added not only to disguise the odor of the dextrine, but to act as preservatives:

1.—White dextrine (5 lb. or), 5½ lb.; water, at 160° F., 1 gal.; oil of wintergreen, 30 min.; oil of clove, 30 min. Dissolve the dextrine in the water; after cooling, add the oils, pour into suitable bottles, cork, and then put in a cool place. In from 1 to 2 weeks the solution will have congealed. However, this "ripening" process may be expedited by exposing the bottles in an ice chamber to a temperature of about 40°. Formaldehyde as a preservative, in this instance, seems to be contraindicated, on account of its interference with the congealing process. This latter, the author is inclined to think, is the result of molecular changes in the dextrine, since after the solution once has set it may be liquefied in a water bath any number of times, and gelation will take place again within less than 24 hours. As little as 4 lb. of dextrine to 1 gal. of water may successfully be used, if desired. The author points out that the best-known of this class of library pastes is broadly covered by a patent, but he naturally asks, how a patent on a solution of dextrine in water can hold.

2.—Take 1 qt. of water and dissolve in it 1 teaspoonful of pure powdered alum. Stir into this enough flour to make a thick cream. Break up every little lump of flour until the mixture is smooth. Stir in next 1 teaspoonful of powdered rosin. Now pour in 1 cupful of boiling water. Stir it all well. When the mixture has thickened for cooking by the boiling water pour into an earthen vessel, cover it up, and keep it in a cool place; add a few drops of oil of cloves. Whenever you want to use any portion of it, take what you need and soften it with a little warm water. This will give you a perfect paste, clean, wholesome, and lasting. You will be surprised how little waste you will have. Should you need larger quantities, in crease the proportions in proper ratio, doubling or trebling each ingredient, according to the magnitude of the business requiring it.—

3.—A solution of 2½ oz. of gum arabic in 2 qt. of warm water is thickened to a paste with wheat flour; to this is added a solution of alum and sugar of lead, 1½ oz. each, in water; the mixture is heated, and stirred about to boil, and is then cooled. It may be thinned, if necessary, with a gum solution.

4.—Flour, 4 oz.; powdered alum, ⅜ oz.; water, 1 qt.; oil of cloves, 20 drops; salicylic acid, 20 grams; alcohol, 2 dr. Mix the flour and alum, and sift; add water slowly until a perfectly smooth mixture results. Then cook over a steady fire or flame until the paste is made. As it is cooling add the clove oil and salicylic acid, dissolved in the alcohol. Bottle in wide-mouthed bottles of 3 or 4 oz. each, cork well, and keep in a cool, dry place.

5.—Wheat flour, 8 oz.; alum and borax, of each, ⅛ oz.; boric acid and oil of sassafras, of each 1-16 oz. Mix in a graniteware dish, using a square redwood paddle. Add all at once cold water.

6. Wheat flour, 10 oz.; rice flour, 8 oz.; tragacanth, 2 oz.; water, 6 pt. Make a paste with the tragacanth and part of the water; make another, by the aid of heat, of the flours and water, and mix.

7.—Wheat flour, 1 lb.; water, 2 pt.; nitric acid, ½ oz.; boric acid, 40 grams; oil of cloves, 20 min. Mix the flour, boric acid and water, and strain; add the nitric acid, apply heat, and stir until the mixture thickens; when nearly cold add the oil of cloves. This paste will remain sweet until all used, and water may be added as it evaporates.

8.—Tragacanth, powdered, 2 parts; white dextrine, 1 part; wheat flour, 6 parts; glycerine, 1 part; cold water, 4 parts; boiling water, 40 parts. Over the tragacanth pour 16 parts of water in active ebullition, stirring it well, and set aside in a moderately warm place. Mix the wheat flour and the dextrine with the cold water, stirring thoroughly, and add the mixture to the tragacanth. Pour the batter thus formed into the rest of the boiling water (24 parts), stirring constantly while doing; add to the glycerine about ¼ of 1 part of salicylic acid (or sufficient of the substance to constitute about ½ of 1% of the whole batch of paste), and pour the mixture into the boiling paste, and under constant stirring cook for 4 or 5 minutes. Remove from the fire and pour into a receptable for preserving; cover with a piece of bladder or oilskin, and tie down. When required for use, take out as much as needed, and tie up again. In this way the paste will keep sweet for a long time. It is white, odorless (or with a faint, agreeable odor), and is a wonderful sticker, where paper or cloth only is concerned. The addition of 2 parts of gum arabic and 3 more parts of glycerine (4 parts in all) converts the product into an unrivaled label paste for glass. The substitution of good glue or isinglass for gum arabic, and the addition of 8 parts of sugar, makes an all-round paste for use on wood, leather, metal, etc.

9.—Gum arabic, 100 parts; starch, 75 parts; white sugar, 21 parts; camphor, 4 parts. Dissolve the gum arabic in a little water; dissolve the starch also in a little water; mix the whole, add the sugar and camphor, put on the water bath, and boil until a paste is formed, but rather thin, because cooling will thicken it.

10.—Starch, 2 dr.; sugar, 1 oz.; acacia, 2 dr.; water, sufficient. Dissolve the gum, add the sugar, and boil until the starch is cooked.

11.—Take 4 oz. of common gelatine, in small pieces, and steep it in 16 oz. of water until it becomes soft; then by the aid of the heat of a water bath dissolve it, and while still hot pour into a mixture of 2 lb. of good flour paste and 1 pt. of water. Heat the whole to boiling, and when thickened remove from the fire; while cooling, add 6 dr. of silicate of soda and stir into the mixture with a wooden spatula. This preparation will keep good for an indefinite period, and is very adhesive. The addition of 2 dr. of oil of cloves is an improvement.

12.—The following, from *Dingler's Journal*, is highly recommended: Let 4 parts by weight of glue soften in 15 parts of cold water for 15 hours, after which the mixture is heated until clear; add 65 parts of boiling water. In another vessel stir 30 parts of starch paste in 20 parts of water. Into this the glue solution is poured. Stir well, and on cooling add 10 drops of carbolic acid.

13.—Mix 1 lb. of rye flour in lukewarm water, to which has been added 1 teaspoonful of pulverized alum; stir until free of lumps. Boil in the regular way or slowly pour on boiling water, stirring all the time, until the paste becomes stiff. When cold add a full ¼ lb. of common strained honey (regular bee honey, no patent mixture); mix well. In labeling, always paste the tin (or other work) and apply the label.

14.—*To Preserve Paste and Mucilage.*—At the Konigliche Lehranstalt fur Obst. und Weinbau, at Geisenheim, recently, a series of experiments were undertaken to determine which, if any, of the ordinary additions to pastes and mucilages for bottle labels prevented fermentation, without injuring the adhesive qualities of the paste. Among the anti-ferments under observation were salicylic acid, boracic acid, thymol, oil of cloves, etc. Without going into minutiae, it was found that dextrine, impregnated with from 0.3 to 0.5% of thymol, produced a paste that has thus far proved all that could be desired.

Special Uses and Special Materials.

1.—*Artists' and Architects'.*—Boil white paper in water for 5 hours, then pour off the water and pound the pulp in a mortar; pass it through a sieve, and mix with some gum water or isinglass glue. It is used in modeling by artists and architects.

2.—*Bill-Sticking Paste.*—Take flour, 25 lb.; alum, in powder, ½ lb.; boiling water, sufficient quantity. This paste will not very long resist the action of wet weather, but may be made to do so by giving the bill, after sticking it, a wash of soap water, sugar of lead solution, or a solution of crude lac in naphtha.

3.—*Cloth, Paste for.*—Use rye-flour paste, adding to it about ¼ the weight of the flour of good glue. As the paste is for immediate use, there is no need of adding alum gum dextrine, or any preservative.

4.—*Envelope Gum.*—a.—The gum used by the United States Government on postage stamps is probably one of the best that could be used, not only for envelopes, but for labels as well. It will stick to almost any surface. Its composition is said to be the following: Gum arabic, 1 part; starch, 1 part; sugar, 4 parts; water, sufficient to give the desired consistency. The gum arabic is first dissolved in some water, the sugar added, then the starch, after which the mixture is boiled for a few minutes in order to dissolve the starch, after which it is thinned down to the desired consistency. Cheaper envelope gums can be made by substituting dextrine for the gum arabic, glucose for the sugar, and adding boric acid to preserve and help stiffen it.

b.—Chromic acid, 2½ parts; stronger ammonia, 15 parts; sulphuric acid, ½ part; cuprammonium solution, 30 parts; fine white paper, 4 parts.

c.—Isinglass, a sufficient quantity; acetic acid, 1 part; water, 7 parts. Dissolve sufficient isinglass in the mixture of acetic acid and water to make a thin mucilage. One of the solutions is applied to the surface of the envelope and the other to the flap. The parts are then fastened together, when the union is so firm as to resist acids, alcohol, hot or cold water and steam. The chromic acid form with the isinglass a combination insoluble in water.

5.—*Gummed Paper.*—Two kinds of gum solutions may be used for the manufacture of this paper, one of which gives a firmer adhesion than the other.—*Paper Digest.* The first solution is obtained as follows: Arabic gum, 1 kgm.; cold water, 1 kgm. The second solution requires: Arabic gum, 1 kgm.; cold water, 3 kgm.; honey, 100 grams; glycerine, 100 grams. When the solution is ready (for the production of which no warm water must be used, as in that case the paper prepared with it would get wrinkled), it is pressed through flannel before using, and spread over the paper by means of a good bath sponge. As underlayer, a smooth, straight piece of pasteboard is used; then the gummed paper, with the gummed side up, is laid upon another piece of thin pasteboard, or in a drying frame, if preferred, and slowly allowed to dry.

6.—*Japanese Cement.*—Mix the best powdered rice with a little cold water, gradually add boiling water until a proper consistency is acquired, being particularly careful to keep it well stirred all the time; boil for 1 minute in a clean saucepan or earthen pipkin. This glue is beautifully white, and almost transparent, for which reason it is well adapted for fancy paperwork, which requires a strong and colorless cement.

7.—*Machine for Pasting and Folding, Paste for.*—Four parts, by weight, of glue, are allowed to soften in 15 parts of cold water for some hours, and then moderately heated until the solution becomes quite clear; 65 parts of boiling water are now added, with stirring. In another vessel 30 parts of starch paste are stirred up with 20 parts of cold water so that a thin, milky fluid is obtained, without lumps. Into this the boiling glue solution is poured, with constant stirring, and the whole is kept at the boiling temperature. After cooling, 10 drops of carbolic acid are added to the paste. This paste is of extraordinary adhesive power, and may be used for leather, cardboard, etc., as well as for paper. The paste in the reservoir should be kept from the air as much as possible, to avoid loss of water by evaporation.

8.—*Matrix, Paste for.*—A correspondent once wrote: "After considerable experiment, I have succeeded in making a paste for matrixes that gives us from 40 to 80 casts, average perhaps 50 to each matrix. I use 2 oz. of French gelatine, dissolved in vinegar, then add to this 1 oz. of alum and 1 qt. of hot water. In a separate vessel dissolve 1 lb. of starch in cold water. Then bring the water in which the gelatine and alum is dissolved to the boiling point, and gradually stir in the dissolved starch, stirring all the time, to prevent lumps. Boil half an hour, stirring all the time; when cold, to a pint of paste add water and 1 oz. of Spanish white to make matrix; use enough water to the paste so as to spread well."

9.—*Paper Bags and Paper Pads.*—a.—Glue, 200 parts; glycerine, 50 parts; syrupy glucose, 10 parts; tannin, 1 part. Cover the glue with cold water, and let stand overnight. In the morning pour off the superfluous water, throw the glue on muslin, and manipulate so as to get rid of as much moisture as possible, then put in a water bath and melt. Add the glycerine and syrup, and stir well in. Finally, dissolve the tannin in the smallest quantity of water possible, and add. This mixture must be used hot.

b.—Best gum arabic, 1 part; simple syrup, 5 parts; rice starch, 1 part; boiling water, sufficient. Dissolve the gum arabic in just enough water to dissolve it. Pour on the starch enough water to make a thick, pasty mass, then mix in the gum solution, and boil until the starch gelatinizes.

c.—The following is very tenacious, and may be used wherever a paste is needed around the shop or laboratory: Gelatine, best hard, 2 parts; arrowroot, 10 parts; alcohol, 8 to 10 parts; water, sufficient to make 100 parts. With a portion of the water make the arrowroot into a thick paste. Soak the gelatine overnight in the residue of the water, then put the vessel on a water bath and heat until the gelatine is completely dissolved. Now add the arrowroot paste under brisk and constant stirring, and let boil until the arrowroot gelatinizes. Remove from the fire, let cool down somewhat, add the alcohol, and stir until cold.

10.—*Paper on Glass, for Ornamental Purposes.*—a.—Best selected gum arabic, 4 parts; powdered tragacanth, 1 part; glycerine, 2 to 3 parts; distilled water, 32 parts. Dissolve the gum arabic in a part of the water, and the tragacanth in the remainder; mix the solutions and stir in the glycerine.

b.—Add to 3 parts of wheat starch 24 to 30 parts of cold water, stir together to a homogeneous mass of about the thickness of syrup. Pour over this, with constant stirring, boiling water until the paste is of the required consistency. Stir until partly cold. Take a portion of the paste and add to it 6 to 15% of liquefied Venice turpentine, rub together until a kind of emulsion is formed, then mix the whole together and work thoroughly.

11.—*Paper Boxes.*—Chloral hydrate, 5 parts; white gelatine, 8 parts; gum arabic, 2 parts; boiling water, 30 parts. Mix the chloral, gelatine and gum arabic in a porcelain container, pour the boiling water over the mixture, and let stand for 1 day, giving it a vigorous stirring several times during the day. In cold weather this is apt to get hard and stiff, but this may be obviated by standing the container in warm water for a few minutes. This paste adheres to any surface whatever.

12.—*Paper Hangers' Paste.*—a.—It is believed that paper hangers' paste, as well as a paste for general purposes, is simply wheat or rye flour, beaten in cold water to perfect smoothness, and the whole just brought to a boil while being constantly stirred to prevent burning. A little creosote or carbolic acid will make it keep much better. Any addition to this paste fails to improve it.

b.—A painters' magazine gives the following: Put 3 pt. or 1 qt. of water, as hot as you can bear your hand in, into a pail; add 1 tablespoonful of pulverized alum. Sift flour into the pail, stirring with the hand. Beat until the paste is so thick that you cannot beat it any longer, and it has about the consistency of dough. Next, pour in boiling water until the paste begins to turn, or cook. Then stop pouring in the water, but stir until the paste is cooked. Paste cooked too much won't hang, hence it is necessary to stop pouring in the water at the turning point. Level the paste off and pour water on top of it to keep it from caking. Let it stand overnight, and in the morning it can be cut in pieces, which may be wrapped in strong paper and carried in a grip. To use, simply thin with water. Thick paste like this will, before it is thinned, keep for months.

13.—*Postage Stamp Mucilage.*—a.—Gum dextrine, 2 parts; water, 5 parts; acetic acid, 1 part. Dissolve by aid of heat, and add 1 part of 90% alcohol.

b.—Dissolve 1 lb. of gum dextrine in 1 pt. of boiling water, strain through flannel, and add 2 oz. of acetic acid. When nearly cold add 4 oz. of alcohol, stir constantly, and finally enough warm water to make 1 qt.

14.—*Powder Paste.*—Some years ago a patent was granted for an adhesive paste consisting of a compound containing flour, starch, or other farinaceous substance, with an alkali, preferably caustic soda or caustic potash, or some other strongly alkaline substance. If the flour be mixed with any of these substances in the form of powder, in the proper proportions, they form a compound which, when mixed with water, will soon assume the consistency of a paste, and will become soluble in water. The action of the alkali on the flour bursts the starch cells and digests or dissolves it, increasing its bulk and reducing it to a paste, which may be thinned by the addition of water, or thickened by the addition of more of the alkali and flour. These compounds are sold as powders, to be mixed with water by the user.

a.—The following formula has been given: Flour, 84 parts; caustic soda, pulverized, 8 parts. In place of the caustic soda pulverized caustic potash may be used. Other forms of alkali, such as strong soda ash, may also be used, but the quantity must be considerably increased until sufficient to digest the flour. It is preferably best to employ caustic soda.

b.—A formula said to answer better for all purposes is the following modification of the above: Flour, starch, or other farinaceous substance, 84 parts; pulverized caustic soda, or potash, 8 parts; ammonium sulphate, 8 parts. To apply it to use, add to it a little water. The ammonium sulphate is used as a neutralizing agent, and counteracts the strong effects of the caustic soda on colored or tinted papers.

15.—*Scrap Books.*—Rice starch, 1 oz.; gelatine, 3 dr.; water, ½ pt.; heat, with constant stirring, until the milky liquid becomes thick and glassy, when the paste is ready. Keep the paste in a tight bottle, with a few drops of clove oil.

16.—*Skins.*—Get 1 lb. of rye flour, put it in a basin, and pour enough boiling water over it to make a stiff paste. It must be made almost as stiff as ordinary dough for puddings, but not quite. Stir, and beat up well with a stick for 3 or 4 minutes; then cover up, and put by for 2 days before using, when it will be much softer, and stick better. Spread thinly and evenly on back of skin with a stiff brush or pad; this will stick firmly, and will not crack.

17.—*Stereotypers' Paste.*—a.—Flour, 5 oz.; white starch, 7 oz.; powdered alum, 1 large tablespoonful; water, 4 qt. Put the flour, starch and alum into a saucepan, and mix with a little of the water, cold, until the whole becomes of the consistency of thick cream. Then gradually add the remainder of the water, which must be boiling, stirring well meanwhile to prevent lumps. Put the mixture over the fire, and stir until it boils; then let it stand until quite cold, when it should look like jelly. When you are ready for work add Spanish whiting, the mixture not to be too stiff to spread readily with the paste brush. Put through a fine wire sieve with a stiff brush, and it is ready for use.

b.—Mix together with the hands, until all lumps are dissolved, 6½ lb. of Oswego starch and 2½ lb. of wheat flour in 6 gal. of water. Then add 12 oz. of common glue which has been previously dissolved in 2 qt. of water, and 2 oz. of powdered alum. Cook until the mixture boils thick. When cold, take out a quantity sufficient for the day's use and add ½ its bulk of pulverized whiting. The whiting should be thoroughly incorporated with the paste, and the resultant mass forced through a sieve having about 20 meshes to the inch. The whiting should be freed from grit.

18.—*Tinfoil, Fastening Paper upon.*—Make a paste by dissolving rye flour in a solution of caustic soda, dilute with water, stirring all the time; add to this paste Venetian turpentine, a few drops for each ½ lb. of flour. Adheres firmly to all metals, tinfoil, glass, etc.

19.—*Tissue Paper.*—(a) Pulverized gum arabic, 2 oz.; white sugar, ½ oz.; boiling water, 3 fl.oz. (b) Common laundry starch, 1½ oz.; cold water 3 fl.oz.; make into a batter, and pour into 32 fl.oz. of boiling water. Mix (a) with (b) and keep in a wide-mouthed bottle.

20.—*Trunkmakers' Paste.*—To 32 parts of sifted wheat flour add 2 parts of rosin and 1 part of alum, both finely powdered, and mix well together. Now add a little at a time, and under constant stirring, enough soft (distilled or rain) water to make a paste about the consistency of cream. Set the vessel in the water bath, and boil for a few minutes, or until the liquid gets thick enough to hold the spoon upright when it is placed so. It is now done, and ready for use.

PUTTY

Putty may be considered as a cement. It is prepared by mixing fine whiting with linseed oil or linseed-oil varnish, the latter drying more quickly. The whiting should be passed through a sieve, the meshes being 42 threads to the inch. It should be dry before sifting, and be thoroughly incorporated with the oil, a tedious operation. Keep in oiled paper or under water. White lead is sometimes mixed with the putty. Color, if desired, with dry colors.

In the mixing of putty, use a stiff putty knife, and mix a large quantity at one time, as it improves with age. Pound your putty on the mixing block to expel the accumulated moisture that might be in the putty, also to make it tough and elastic. When you are pounding the putty add more dry pigment, if needed, as the more pigment you use the better the putty will be; but care should be taken not to use too much dry pigment, making your putty too dry. After mixing, put it in a clean can, and cover with clean water, for future use. A good putty knife for puttying gears may be made out of an old ½-inch wide spatula, cut off about 3 inches from the end of the ferrule.

To Soften Putty that has become hard, break the putty up in as small pieces as possible, put in an iron kettle with enough water to cover it, add a little raw linseed oil, and let it boil, and stir well while hot. The putty will readily absorb the oil; pour off the water, and when cool work it into shape, and it will be found good as new. This process is recommended by a large paint concern.

1.—Keg white lead, ½ lb.; dry white lead, ½ lb.; pale Japan, 3 oz.; quick rubbing varnish, 3 oz. Quicken up with Reno's raw or burnt umber, keystone filler, or dry lampblack.

2.—Dry white lead, ⅝ part; keg white lead, ¼ part; mixed rough stuff, ⅛ part; rubbing varnish, ⅛ part; pale Japan, ¼ part; turpentine, ¼ part.

3.—*Black Putty for Irons.*—Dry lampblack, 3 parts; dry white lead, 1 part; dry keystone filler, 1 part; rubbing varnish and japan, half and half.

4.—*Black Putty for Hearse Builders.*—Dry white lead, 2 parts; keg white lead, 2 parts; dry lampblack, 1 part; dry keystone filler, 1 part; rubbing varnish, 2-3 part; japan, 1-3 part. Take black velvet or plush, and unravel it so as to secure the short fibers of the material, which, when mixed with the putty in the same manner as hair is mixed with mortar, will bind it firmly together, and no jar of the vehicle will cause it to crack and fly out. This putty is excellent for bedding the glasses of hearses, and is used by most all of the hearse builders in preference to any other.

5.—*Extra Rapid Putty.*—Dry white lead, 3 parts; japan, 2 parts; drying oil, 1 part. If too thin, add more lead. This putty will harden very rapidly, and dries without any shrinkage, tack or softness.

6.—*French Putty.*—a.—Ruban prepares this substance by boiling 7 parts of linseed oil with 4 parts of brown umber for 2 hours; 5½ parts of chalk and 11 parts of white lead are then added, and the whole well mixed. This putty is very durable, and adheres well to wood, even though not previously painted.

b.—Gum arabic, 1 part; water, 2 parts; potato starch, 4 parts.

7.—*Glazing Putty.*—Keg white lead mixed with japan, 2 parts; rubbing varnish, 1 part; turpentine, 1 part; add a little dry color the same as the job is to be when painted. Make the paint a stiff paste or soft putty, the same as the job they are used on, by using consistency, and with a stiff brush spread this on the body and running parts.

8.—*Infusorial Earth Putty.*—Washed infusorial earth (kieselguhr), 10 parts; litharge, 8 parts; slaked lime, 5 parts; boiled linseed oil, 6 parts; red lead, 1 part; zinc white, 1 part. This putty, in a few months, becomes as hard as fine-grained sandstone, and can be employed advantageously as a filling cement for stone.

9.—*Oil Putty, White.*—a.—Very fine dry whiting, 3 parts; keg white lead, 1 part; boiled oil, and a little litharge to make it dry hard.

b.—Keg white lead, 3 parts; dry white lead, 2 parts; dry bolted whiting, 1 part; japan and boiled oil, half and half.

10.—*Soft Putty.*—a.—Whiting, 10 lb.; white lead, 1 lb.; mix with the necessary quantity of boiled linseed oil, adding to it ½ gill of the best olive oil. The last prevents the white lead from hardening, and preserves the putty in a state sufficiently soft to adhere at all times, and not, by getting hard and cracking off, suffering the wet to enter, as is often the case with ordinary hard putty.

b.—A very strong putty is made of boiled oil and whiting, for exposed situations, as skylights, but is not adapted for keeping; it gets too hard.

c.—Putty for good inside work is improved by adding white lead.

d.—Another putty which requires to be made as wanted (as it gets hard almost immediately) is composed of red lead in powder, mixed with boiled oil and turpentine varnish, and is used for fronts of houses, or any place requiring a hard putty.

e.—Some manufacturers prepare an oil for th epurpose of melting 20 lb. of rosin and mixing it with 90 lb. of linseed oil, the rosin being used for economy's sake.

f.—For some purposes a drying oil may be used with the whiting. This is made by mixing 1 gal. of linseed oil, 12 oz. of litharge, 1 oz. of sugar of lead, and 1 oz. of white vitriol; simmer for some time, allow to cool, and when settled draw it off.

11.—*Wax Putty.*—Fuse together 4 lb. of yellow wax, 2 lb. of tallow, 1 lb. of oil of turpentine and 6 lb. of Venice turpentine.

12.—*White Putty.*—a.—Dry white lead, 3 parts; keg white lead, 1 part; rubbing varnish and japan, half and half.

b.—Keg white lead, 4 parts; dry white lead, 1 part; varnish and japan gold size, half and half.

c.—Dry white lead, ½ part; pulverized soapstone, ¼ part; dry oxide of zinc, ⅛ part; dry white stone ocher, ⅛ part; white rubbing varnish, ½ part; white japan, ⅜ part; turpentine, ⅛ part.

d.—Dry white lead, 2 parts; keg white lead, 1 part; rubbing varnish and japan, half and half.

e.—Dry white lead, mixed with half rubbing varnish and half japan.

Wood Putty.

There are a great number of wood putties. They serve for filling up the faults or gaps in wood that has been thoroughly dried. Suitable coloring matter should be added to them to make them correspond in color to the wood.

1.—*Floors.*—Litharge, 1 part; plaster of paris, 2 parts; glue, 1 part; water, 8 parts; cement, 4 parts; sawdust, 2 parts; casein, 5 parts; water, 3 parts; ammonia, 3 parts; burned lime, 3 parts.

2.—*Floors of Soft Wood, Intended to be Washed.*—a.—Casein, by weight, 500 parts; water, by weight, 4,000 parts; spirit of sal ammoniac, by weight, 500 parts; burnt lime, by weight, 250 parts.

b.—Glue, 2 parts; water, 14 parts; cement, lime, 5 parts; sawdust, 3 to 4 parts. Both the above must be prepared immediately before use.

3.—*Floors to be Varnished.*—Glue, 2 parts; water, 14 parts; gypsum, 5 parts; yellow ocher, 2 to 4 parts.

4.—*Gypsum.*—This putty is used only

for very ordinary woodwork. It is composed of burnt gypsum, stirred with glue water. It must be used at once, as it hardens very rapidly.

5.—*Lime.*—Rye flour, 10 parts; slaked lime, 5 parts; linseed-oil varnish, 5 parts; umber, q. s. to color.

6.—*Sawdust Oil Putty.*—Very fine sawdust is made into a paste by moistening with linseed-oil varnish and long kneading. The mass is very plastic.

7.—*Sawdust Glue Putty.*—Water, 20 parts; glue, 1 part; fine sawdust, as required. Completely dissolve the glue by boiling in water; pour the sawdust, in a thin stream, into the liquid, which is kept in constant motion by stirring.

ADHESIVES FOR SPECIAL PURPOSES

BOOKBINDERS' AND STATIONERS' GLUE AND PASTE

1.—Use best carpenters', or white glue, to which, after soaking and heating, add 1-20 its weight of glycerine.

2.—Lehner publishes the following formula for making a liquid paste or glue from starch and acid: Place 5 lb. of potato starch in 6. lb. of water, and add ¼ lb. of pure nitric acid. Keep it in a warm place, stirring frequently for 48 hours. Then boil the mixture until it forms a thick and translucent substance. Dilute with water, if necessary, and filter through a thick cloth. At the same time another paste is made from sugar and gum arabic. Dissolve 5 lb. of gum arabic and 1 lb of sugar in 5 lb. of water, and add 1 oz. of nitric acid, and heat to boiling. Then mix the above with the starch paste. The resultant paste is liquid, does not mold, and dries on paper with a gloss. It is useful for labels, drappers, and fine bookbinders' use.

3.—*Cloth Books, etc.*—(a) White glue, 4 oz.; cold water, 8 fl.oz. Soak glue 4 hours in the cold water, then dissolve in a gluepot. (b) Corn starch, 4 oz.; cold water, 8 fl.oz.; mix, and pour into 16 fl.oz. of boiling water. Mix (a) with (b) and gently heat for about 10 minutes. If wanted elastic, add 4 fl.oz. of glycerine.

4.—*Paper (Parchment).*—a.—Mix ordinary glue with about 3% of potassium or ammonium bichromate, in the dark. This may be used on the paper, and after exposure to light becomes perfectly insoluble in boiling water. This glue has been very largely used in Germany for joining the parchment paper envelopes of pea sausages. The strips of paper joined by this glue are dried quickly and exposed to light till the glue changes to a brownish color; they are then boiled with water containing about 3% of alum till all the excess of alkaline bichromate is extracted, and then washed in water and dried.

b.—White glue, 20 parts; dilute acetic acid, 40 parts; potassium bichromate, 1 part. Soak the glue in water 12 hours, and then dissolve in a water bath; add to this the aqueous solution of the bichromate. It must be done in the dark, as dry or sunlight will make the mixture insoluble. This may also be used as a putty for glass.

5.—*Tablets and Pads.*—a.—Good, clear cabinet glue, 4 oz.; acetic acid, 3 fl.oz.; water, 2 fl.oz.; glycerine, ½ fl.oz.; aniline (any color preferred), q. s. Place the glue, acetic acid and water in a wide-mouthed bottle or jar, set in a warm place, and stir occasionally until the glue is dissolved. If needed at once, the process may be hastened by dissolving the glue by means of a water bath Add the glycerine and enough of a solution of aniline, in water, to give the desired color. Should the glue become too thick, add a little water till the proper consistency is restored. This preparation has the advantage of being easily made, and is always ready for use.

b.—For 50 lb. of the best glue (dry) take 9 lb. of glycerine. Soak the glue for 10 minutes, heat to solution, and add the glycerine. If too thick, add water. Coloor with aniline.

c.—A good liquid glue, without acid, may be prepared as follows: Slaked lime, 40 parts; sugar, 60 parts; water, 180 parts; glue, 60 parts. Dissolve the lime and sugar in the water, heated to 75° C.; then introduce the glue, and after allowing to swell, again apply heat until dissolved.

d.—Brown glue, No. 2, 2 lb.; sodium carbonate, 11 oz.; water, 3½ pt.; oil of clove, 160 min. Dissolve the soda in the water, pour the solution over the dry glue, let stand overnight, or till thoroughly soaked and swelled, then heat carefully on a water bath until dissolved. When nearly cold stir in the oil of clove. By using a white glue, a finer article, fit for fancy work, may be made.

e.—Glue, 4 lb.; glycerine, 2 lb.; linseed oil, ½ lb.; sugar, ¼ lb.; aniline dyes, q. s. to color. The glue is softened by soaking it in a little cold water, then dissolved, together with the sugar, in the glycerine, by aid of heat over a water bath. To this the dyes are added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows: Glue, 1 lb.; glycerine, 4 oz.: glucose syrup, about 2 tablespoonfuls; tannin, 1-10 oz. Give the compositions an hour or more in which to dry, or set, before cutting or handling the pads.

f.—Best glue, 5 oz.; water, 1 oz.; calcium chloride, 1 oz. Dissolve the calcium chloride in the water, add the glue, macerate until it is thoroughly softened, and then apply heat until completely dissolved. This is known as "syndeticon," and, like the preceding formulas, is a liquid glue.

g.—*Tableting Press.*—A screw press, with a piece of smooth board on the bottom and a block above, to clamp and hold the paper, answers very well as a tableting press. After the paper is squared up, and all edges even, place in the press and fasten securely. Apply tableting glue to the top edges by means of a flat bristle brush. Allow to remain in the press until glue is dry. Printing to be tableted should be permitted to dry thoroughly at least 12 hours before being placed in the tableting press, otherwise it will "set off"—that is, partially transfer the impressions, and soil the backs of the sheets.

FIREPROOF ADHESIVES

1.—Iron filings, 100 parts; hydraulic lime, 20 parts; quartz sand, 25 parts; sal ammoniac, 3 parts. There are formed into a paste with vinegar, and then applied. The cement is left to dry slowly before heating.

2.—Iron filings, 180 parts; lime, 45 parts; common salt, 8 parts. These are worked into a paste with strong vinegar. The cement must be perfectly dry before being heated. By heating it becomes stone hard.

3.—Linseed or almond meal, mixed to a paste with milk, lime water, or starch paste; resists a temperature of 500° F. (260° C.).

4.—Clay is puddled with water, and to it is added the greatest possible quantity of sand which has been passed through a hair sieve; the whole is worked up in the hands, and applied in coats more or less thick on vessels needing protection from the direct action of fire.

5.—Sifted manganese peroxide, 1 part; pulverized zinc white, 1 part; sufficient commercial soluble glass to form a thin paste. To be used immediately. Becomes very hard, and presents a complete resistance to red heat and boiling water.

6. As a coating for glass vessels, to protect them from injury during exposure to fire, pipeclay and horse dung are made into a paste with water. This composition is applied by spreading it on paper; it is used by pipemakers, and will stand the extreme heat of their furnaces for 24 hours without damage.

7.—Shredded tow or plumbago is substituted for the horse dung.

8.—Clay, 5 parts; iron filings, 1 part: linseed-oil varnish, q. s. to mix.

9.—Common clay, dried and pulverized, 10 parts; iron filings, 4 parts; common salt, 1 part; borax, 1 part; manganese peroxide, 2 parts.

10.—China clay, mixed with asbestos. Beat well before applying; use no more water than absolutely necessary. This is said to stand a high heat. Not recommended for household use.

11.—Calcine oyster shells; grind, and sift: reduce to the very finest powder with a muller, and beat into a paste with white of egg; press the broken pieces together firmly. This cement stands both heat and water.

12.—Stir the white of an egg into a stiff solution of glue.

13.—*Beale's.*—Chalk, 60 parts; lime and salt, of each, 20 parts; sand, 10 parts (English books of receipts give Barnsey sand); iron filings or dust, 5 parts; blue or red clay, 5 parts. Grind and calcine. Patented as a fireproof cement.

LABELING MUCILAGE AND PASTE

1.—The following is highly recommended by Dr. Carpenter: Dissolve 2 oz. of gum arabic in 2 oz. of water, then add ¼ oz. of soaked gelatine (heat required), 30 drops of glycerine, and a lump of camphor. See also *Cements* and *Pastes.*)

2.—A good mucilage for labels is made by macerating 5 parts of good glue in 18 to 20 parts of water for a day, and to the liquid add 9 parts of rock candy and 3 parts of gum arabic. The mixture can be brushed upon paper while still lukewarm.

3.—Dextrine, 2 parts; acetic acid, 1 part; water, 5 parts; alcohol, 1 part.

4.—Gelatine, 2 parts; rock candy, 1 part; water, 3 parts.

5.—White dextrine, 5 lb.; water, heated to about 160°, 1 gal.; oil of wintergreen, ⅛ dr.; oil of cloves, ⅛ dr. Dissolve the dextrine in the hot water by stirring, when cool add the oils, and stir. Then pour the paste into suitable receptacles—glass, wide-mouthed bottles, or porcelain jars—cork, and put in a cool place, where the paste may congeal and ripen. The ripening process takes about a week.

6.—White dextrine, 1 lb.; syrupy glucase, av.oz.; aluminum sulphate, 1 av.oz.; sodium benzoate, 20 gr.; water, 24 fl.oz. Mix the white devtrine, aluminum sulphate and sodium benzoate with a portion of the water, rubbing to a smooth paste; add the glucose and the remainder of the water, and heat the mixture on a water bath, with occasional stirring, until it has become translucent; strain if necessary.

7.—Macerate in a small quantity of water 120 grams of gum arabic, and in another vessel, with a similar quantity of water, 30 grams of tragacanth. When the latter is thoroughly swollen rub it up until it makes a homogeneous magma, and to this add the gum arabic. Force the mass through a linen strainer, and to the mixture add 120 c. c. of glycerine and 250 c. c. of oil of thyme, and bring the volume up to 1 l. by adding distilled water and thoroughly incorporating the whole. This preparation should be preserved in well-stoppered bottles.

8.—Rye flour, 4 oz.; alum, ½ oz.; water, 8 oz. Rub to a smooth paste, pour into 1 pt. of boiling water, heat until thick, and finally add 1 oz. of glycerine and 30 drops of oil of cloves.

9.—Rye flour, 4 oz.; water, 1 pt. Mix, strain, add nitric acid, 1 dr.; heat until thickened, and finally add carbolic acid, 10 min.; oil of cloves, 10 min.; glycerine, 1 oz.

10.—Dextrine, 8 parts; water, 10 parts; acetic acid, 2 parts. Mix to a smooth paste, and add 2 parts of alcohol. This is suitable for bottles of wood, but not for tin, for which the first 3 are likewise adapted.

11.—A paste very similar to 3, but omitting nitric acid and glycerine, is also recommended by Dr. H. T. Cummings.

12.—A good paste for labels for specimens. Starch, 3 dr.; white sugar, 1 oz.; gum arabic, 2 dr.; water, q. s. Dissolve the gum, add the sugar, and boil until the starch is cooked.

13.—A good paste is made by soaking flake tragacanth in sufficient cold water that the brush will not sink into the paste when finished. To prevent souring, add to the water 2 gr. of hydronaphthol (dissolved in a little alcohol) for each pint, and a few drops of clove oil for scent. To keep away the flies, add some oil of pennyroyal.

14.—Starch paste, with which a little Venice turpentine has been incorporated while it is warm.

Labels on Cork.

Gum tragacanth, 1 oz.; gum arabic, 4 oz. Dissolve in water, 1 pt.; strain, and add thymol, 14 gr., suspended in glycerine, 4 oz.; finally add water to make 2 pt.

Labels on Flower Pots.

Use thin paper for label, and attach with white gelatine in solution, to which has been added 1% of bichromate of potash. This must be done in a dark or obscure room. Then expose the labels to sunlight. After writing, varnish with a solution of shellac in alcohol.

Labels on Glass.

1.—The *Druggist's Circular and Chemical Gazette* says mucilage of tragacanth is a satisfactory agent. The mucilage is made by simply pouring over the gum enough water to a little more than cover it, and then, as the gum swells, adding more water from time to time, in small portions, until the mucilage is brought to such a consistency that it may be easily spread with the brush. The mucilage keeps fairly well without the addition of any antiseptic. Flour paste may answer better if the labels are on unusually heavy paper; it is rather more troublesome to make, on account of the necessary boiling, and does not keep so well as the tragacanth paste. By dissolving dextrine in cold water, a tenacious paste is obtained. It has the disadvangtage of possessing a slight odor which is not agreeable.

2.—According to a German photographic journal, the following formula yields a paste which will serve equally well to affix labels to glass, porcelain or metal: Acacia, 4 dr.; tragacanth, powdered, 2 dr.; glycerine, 1½ fl.dr.; thymol, 5 grams; alcohol, 1 dr.; water, sufficient to make 4 oz. Dissolve the acacia in ½ oz. of water; rub up the tragacanth with 1 oz. of water, mix the two, and strain through a cloth. Then add the glycerine and the thymol, first dissolving the latter in the alcohol.

3.—Yellow dextrine, 8 oz.; thymol, 10 gr.; dissolve in cold in lukewarm water, 18 fl.dr. Boiling water should not be used with dextrine, as it impairs its adhesiveness.

4.—Make a paste out of 280 parts of mucilage, 0 parts of water, and 2 or 3 parts of aluminum sulphate, dissolving the sulphate in the water before adding the mucilage.

5.—(a) Pulverized gum arabic, 4 oz.;

boiling water, 6 fl.oz. (b) Glycerine, 2 oz. Dissolve (a), then add (b).

Labels on Metal.

1.—To attach paper to metal, and produce strong adherence, as desired for cards and labels, a small quantity of carbonate of potash should be added to the paste.

2.—Paint the label (which must be thoroughly dried) with collodion; apply a thin film of ordinary turpentine or of the lacquer with which the metal is covered, and press the label upon the surface of the container. If the vessels to be labeled are cylindrical in form, it is advantageous to add a few drops of castor oil to the lacquer used for fastening the paper.

3.—A label paste for paper or cloth to metals is composed of: Starch, 20 parts; sugar, 10 parts; zinc chlorite, 1 part; water, 200 parts. Mix the ingredients to a smooth paste, and heat cautiously until it thickens. Stir down, remove from the fire, and let cool.

4.—M. Eliel gives the following formula for a mixture which can be used for metal, glass or wood: Gum tragacanth, 30 grams; acacia gum, 120 grams; water, 500 c. c. Dissolve, filter, and add 2½ grams of thymol, suspended in 120 c. c. of glycerine; then add enough water to make up the bulk to 1 l. This bath will keep a long time.

5.—Dextrine, 400 grams; water, 100 grams; grape sugar, 20 grams; aluminum sulphate, 10 grams. The whole is heated for 30 minutes to about 90° C. to obtain the best adhesive quality.

6.—Water, 1 pt.; borax, 1 oz.; shellac, 5 oz. Boil until the latter is dissolved. Thin with boiling water. If necessary, use hot.

7.—Boil 2 oz. of shellac and ½ oz. of borax in 8 oz. of water. Give the space on the tin to be covered with the label one coat of this solution; dry and apply the label with ordinary mucilage.

8.—Gum arabic, 50 parts; glycerine, 10 parts; water, 30 parts; antimony, chloride, liquid, 2 parts. Mix.

9.—*Iron.*—Make a paste of rye flour and glue; add linseed-oil varnish and turpentine, ½ oz. of each to 1 lb. of the paste.

Labels on Nickel.

Dissolve 40 parts of dextrine in 50 parts of water, 2 parts of glycerine and 1 part of glucose, and heat.

Lables on Stone.

Melt together equal parts of asphalt and gutta percha. Use hot. The surfaces to be joined should be perfectly clean and dry.

Labels on Tin.

1.—Paste for tin should not be too thin, and the tin should be free from grease. New tin generally has an oily or greasy surface, due to the tallow or oil used in the plating process. The grease may be removed with an alkali or with benzine, but in a factory where much labeling is done it is better to slightly roughen the surface of the tin where the label is to be placed with a piece of fine sandpaper, No. 0.

2.—Moisten the gummed labels with pure diluted hydrochloric acid (1 + 1) instead of water, and paste them on at once. Allow the vessel to stand in the air for 2 days, so that the excess of acid not combined with the tin may evaporate. For pasting paper labels on varnished tin receptacles, as well as varnished wood and pasteboard, use hot glue to which about ¼ of turpentine has been added. The turpentine partly dissolves the varnish and effects a firm adhesion of the labels to the vessels.

3.—Put a little calcium chloride in the paste, or some glycerine.

4.—Tragacanth, 1 oz.; acacia, 4 oz.; thymol, 14 grams; glycerine, 4 oz.; water, sufficient to make 2 pt. Dissolve the gums in 1 pt. of water, strain, and add the glycerine, in which the thymol is suspended; shake well, and add sufficient water to make 2 pt. This separates on standing, but a single shake mixes it sufficiently for use.

5.—Gum arabic, 12 grams; gum tragacanth, 3 grams; water, 60 grams; thymol, 0.10 gram; glycerine, 12 grams. Dissolve the gums in the water, strain through cloth, then add the thymol, previously mixed with the glycerine, and enough to make the whole weigh 120 grams.

6.—*Labels, Cements or Mucilages for Attaching to Tin.*—a.—Shellac, 4 parts; borax, 2 parts; water, 30 parts; boil until the shellac is dissolved.

b.—Add 4 oz. of dammar varnish to 1 lb. of tragacanth mucilage.

c.—Balsam of fir, 1 part; turpentine, 3 parts; use only for varnished labels.

d.—Butter of antimony is good to prepare the tin for the label.

e.—Venice turpentine, added to good

starch paste, makes an excellent mounting medium.

f.—Use liquid glue or glue dissolved in acetic acid.

g.—Add 1 oz. of tartaric acid to each lb. of flour used in making flour paste.

h.—Add 10% of flour to tragacanth mucilage.

i.—Corrosive sublimate, 125 parts; wheaten flour, 1,000 parts; absinthe, 500 parts; tansy, 500 parts; water, 15,000 parts. This cement is useful for vessels which are kept in a damp place.

j.—Starch, 100 parts; strong glue, 50 parts; turpentine, 50 parts; the whole boiled in water. This cement dries quickly.

7.—Tragacanth, in powder, 2 parts; boiling water, 40 parts; wheat flour, 6 parts; white dextrine, 1 part; cold water, 4 parts. Mix the tragacanth with 16 parts of boiling water, stir well, and set aside. Mix the flour and dextrine, with the cold water, and add it to the tragacanth. Have the residue of the water in active ebullition, and pour it on the mixture, stirring it vigorously while it is being poured. To the result add 1 part of glycerine, and the same amount of salicylic acid, put on the fire, and let the whole boil for 3 or 4 minutes, stirring all the time. The addition of about ¼ of 1% of butter of antimony to an ordinary good flour or starch paste will make it adhere to tin; in fact, there are a number of substances that may be added that will have the same effect—ammonia water, aluminum sulphate, etc.

8.—(a) Brown sugar, 2 lb.; boiling water, 16 fl.oz. (b) French gelatine, ½ oz.; water, 4 fl.oz. (c) Corn starch, 12 oz.; beat up with cold water, 12 fl.oz.; pour the butter into boiling water, 32 fl.oz. Continue boiling (c), if necessary, until the paste is translucent. Dissolve (a) and (b) separately, and then mix with (c). This paste is very adhesive, and labels pasted with it will adhere nicely, even in a damp place. The sugar in its composition also renders it proof against cracking when exposed to a dry atmosphere.

MINERALS

1.—Prof. Alex. Winchell is credited with the invention of a paste which is said to be valuable for affixing labels to mineral specimens, and for repairing fractured ones. It is made by the following formula: Clear gum arabic, 2 oz.; starch, 1½ oz.; white sugar, ½ oz.; water, a sufficient quantity. Powder the gum arabic, and dissolve it in as much

water as the laundress would use for the quantity of starch indicated. Dissolve the starch and sugar in the gum solution. Then cook the mixture in a vessel suspended in boiling water until the starch becomes clear. The cement should be as thick as tar, and kept so. It can be kept from spoiling by dropping in a lump of camphor or a little oil of cloves or sassafras. The addition of a small amount of sulphate of aluminum will increase the effectiveness of the paste, besides helping to prevent decomposition.

2.—Use best fish glue (hot) and tie well.

3.—Starch, ¼ oz.; white sugar, 1 oz.; gum arabic, ¼ oz. Dissolve the gum in a little hot water, and the sugar and starch, and boil until the starch is cooked.

4.—*Wollaston's White Cement for Large Objects.*—Beeswax, 1 oz.; rosin, 4 oz.; powdered plaster of paris, 5 oz. Melt together. To use, warm the edges of the specimen, and use the cement warm.

NATURALISTS' CEMENT

This cement is employed by naturalists for mounting specimens, by artificial flower makers, by confectioners to stick ornaments on their cakes, etc.

1.—Mucilage of gum arabic, thickened with starch powder or farina, with the addition of a little lemon juice. Sometimes the mucilage is used alone.

2.—*Buckland's Cement for Labels.*—Gum arabic, 2 oz.; starch, 1½ to 2 oz.; sugar, ½ oz. All materials should be pulverized. It can be kept dry and mixed up as used.

Botanical Specimens.

1.—Powdered tragacanth, 30 parts; powdered gum arabic, 20 parts; glycerine, 30 parts; water, 60 parts; corrosive sublimate, 1 part; boiling water, 240 parts. Mix the gums with the glycerine and water, in a mortar, with vigorous stirring. Dissolve the sublimate in the boiling water and add the solution to the mixture. When cold, a few drops of oil of cloves or wintergreen may be added.

2.—*Ferns and Seaweeds.*—Gum arabic, 5 parts; white sugar, 3 parts; starch, 2 parts; a very little water. Boil until thick and white.

3.—*Entomologists' Cement.*—a.—Isinglass and thick mastic varnish, equal parts.

b.—Dissolve gum ammoniac in alcohol, add the best isinglass, with gentle heat. It melts at a gentle heat.

4.—*Pollen and Starch.*—The following

formula was originally devised by Charles Bulloch: Selected acacia, 4 dr.; glycerine, 3 dr.; distilled water, 3 dr.; thymol, about 1 gram to every 3 or 4 oz. Place the ingredients in a wide-mouthed bottle, cork carefully to exclude dust, and put in a warm place to remain until solution is effected. The latter may be hastened by occasional stirring from the bottom with a bone spatula. When complete solution has been secured, strain the liquid through double folds of a silk handkerchief, or through fine linen. Under ordinary circumstances (at the temperature of the room) this will require a week, but the process can be accelerated by the application of a gentle heat. All of the work is rendered unnecessary if one has a jacketed filtering apparatus. Absorbent cotton in the delivery tube of the funnel will clear the liquid of all insoluble matter, dirt, etc., and of air. For cells, use zinc-white cement.

Organic Specimens, Antiseptic Paste (Poison) for.

(a) Wheat flour, 16 oz.; beat to a batter with 16 fl.oz. of cold water; then pour into 32 fl.oz. of boiling water. (b) Pulverized gum arabic, 2 oz.; dissolve in boiling water, 4 fl.oz. (c) Pulverized alum, 2 oz.; dissolve in boiling water, 4 fl.oz. (d) Acetate of lead, 2 oz.: dissolve in boiling water, 4 fl.oz. (e) Corrosive sublimate, 10 gr. Mix (a) and (b) while hot, and continue to simmer; meanwhile stir in (c), and mix thoroughly; then add (d); stir briskly, and empty in the dry corrosive sublimate. This paste is very poisonous. It is used for anatomical work and for pasting organic tissue, labels on skeletons, etc.

Shells and Other Specimens, Paris Cement for Mending.

Gum arabic, 5 parts; sugar candy, 2 parts; white lead, enough to color.

PHOTOGRAPHIC MOUNTANTS

In the *Photographic Times*, Mr. W. H. Gardner collects together a number of formulae of various mountants, of which we give the following:

1.—Gelatine Mountant.—Cooking gelatine, 1 oz.; 95% alcohol, 10 oz..; glycerine, ½ to 1 oz. Soak gelatine in cold water for an hour or more, take out and drain off all the water which will go, add to alcohol in wide-mouthed bottle; add ½ to 1 oz. of glycerine, according as gelatine is of a hard or soft kind; put bottle in hot water, with occasional shaking, until gelatine is quite dissolved. Will keep indefinitely, and has only to be heated when wanted for use.

2.—Permanent Paste.—Arrowroot, 10 parts; water, 100 parts; gelatine, 1 part; alcohol, 10 parts. Soak the gelatine, in the water, add the arrowroot, which has first been thoroughly mixed with a small quantity of the water, and boil 4 or 5 minutes. After cooling, add the alcohol and a few drops of carbolic acid or oil of cloves.

3.—Best Bermuda arrowroot, 1¾ oz.; sheet gelatine or best Russian glue, 80 gr.; water, 15 oz.; methylated spirit, 1 oz. Put the arrowroot into a small pan, add 1 oz. of water, and mix it up thoroughly with a spoon, or the ordinary mounting brush, until it is like thick cream; then add 14 oz. of water, and the gelatine, broken into small fragments. Boil for 4 or 5 minutes, set it aside until partially cold, then add the methylated spirit and 6 drops of pure carbolic acid. Be very particular to add the spirit in a gentle stream, stirring rapidly all the time. Keep it in a corked stock bottle, and take out as much as may be required for the time and work it up nicely with the brush.

4.—Starch Paste.—Pour cold water on good laundry starch to barely moisten it. Then stir in cold water until proper consistency is reached. Squeeze through canvas, if not free from lumps. Starch paste should be freshly made for each batch of prints.

5.—Allow 4 parts by weight of hard gelatine to soften in 15 parts of water for several hours, and then moderately heat until the solution is quite clear, when 65 parts of boiling water should be added while stirring. Stir, in another vessel, 30 parts of starch paste with 20 parts of cold water, so that a thin milky fluid is obtained, without lumps. Into this the boiling gelatine solution should be poured while constantly stirring, and the whole kept at a boiling temperature. When cool, add to the whole 10 drops of carbolic acid to prevent souring. This makes a very tenacious paste.

6.—Casein Mucilage.—Heat milk with a little tartaric acid, whereby casein is separated. Treat the latter, while still moist, with a solution of 6 parts of borax to 100 parts of water, and warm gently while stirring, which will cause the casein to be dissolved. Of the borax solution enough should be used to leave only a little undissolved casein behind.

7.—Good Mounting Paste.—Add to 250 c. cm. of concentrated gum solution 2 parts of gum to 5 parts of water, a solution of 1 gram of sulphate of alumina in 20 c. cm. of water. Alum does not answer the purpose as well. The addition of the sulphate is effective, in that this gum is not so readily softened by moisture, and besides, wood can be fastened to wood by means of it. Its adhesive qualities are, in general, greater than those of pure gum arabic.

8.—Impervious Paste.—Soak ordinary glue in water until it softens, remove it before it has lost its original shape, and dissolve in ordinary linseed oil on a gentle fire until it acquires the consistency of a jelly. This paste may now be used for all kinds of substances, as, besides strength and hardness, it possesses also the advantage of resisting the action of water.

9.—Thin Mucilage.—A paste that will not draw engravings when pasted down on paper must be thin. A mixture of equal parts of gum tragacanth and gum arabic forms, with water, a thinner mucilage than either one alone.

10.—Liquid Glue.—With any desired quantity of glue use ordinary whisky instead of water. Break the glue into small fragments, and introduce these into a suitable glass vessel, and pour the whisky over them. Cork tightly, and set aside for 3 or 4 days, when it will be ready for use. The whisky must not be too strong, and a little heat is generally required.

11.—Same as above, except that acetic acid is used in place of whisky, and that the bottle containing the ingredients must be placed in hot water to dissolve the glue.

12.—Glue, 8 oz.; water, 8 oz.; nitric acid, 2½ oz. Dissolve the glue in the water by immersing the vessel containing the same in hot water. When solution is effected add the acid. Effervescence will take place with the evolution of orange nitrous fumes. Now cool. It should be kept in a well-stoppered bottle, and will remain permanently liquid.

As regards the formulae collected by Mr. Gardner, we may remark, says the *Photo. Review*, that of the above Nos. 12, 11 and 8 are quite unfit for mounting silver prints, although they may be useful for other work in the studio; Nos. 11 and 12 for cardboard and light woodwork, where the presence of acid is not likely to be detrimental; and No. 8 (which is really an emulsion of glue and linseed oil, and requires well beating together) for cementing articles likely to be exposed to dampness. Strips of cloth used to make the developing room light-tight may well be cemented with No. 8, especially if 10 gr. of finely powdered bichromate of potash be stirred into each ounce just before use.

The desirability of employing Nos. 6 and 7 as mountants for silver prints is open to doubt, although these are excellent for cementing all such ordinary materials as come under the denomination of stationery.

We thus have left adhesives Nos. 1, 2, 3, 4, 5 and 9 as quite safe for silver prints if good materials are used, and do not become decomposed subsequently. Gelatinous mountants made with a considerable proportion of alcohol, like No. 1 or No 10, have the advantage of not considerably stretching either mount or print, and are especially useful when prints (whether silver or Woodbury type) have to be mounted on thin card, as book illustrations. In the case of Nos. 2 and 3 the alcohol is used mainly as an antiseptic, and is not present in sufficient quantity to have much influence as a preventive of stretching or cockling. The simple starch paste, No. 4, is not satisfactory in all instances, owing to want of sufficient adhesion, in which case it is an excellent plan to adopt No. 5, in which starch and gelatine are used together.

13.—The following has been suggested as a very desirable substitute for the ordinary pastes used for mounting photo prints. It is said that it can be used so as to scarcely swell the paper at all, avoiding the objectionable cockling so much complained of: Thick, well boiled clear starch (corn) paste, 1 lb.; glucose syrup ("A" clear), 7 oz.; white curd soap, ½ oz.; flowered dextrine, 5 oz.; borax, ⅛ oz. clove oil, a few drops. All are heated over the water bath, and thinned down to the proper consistency (if thin paste is required) with fresh skim milk. It is advisable to use the paste warm and as thick as possible.

14.—The following is a satisfactory mountant for all kinds of prints: White dextrine, 75 grams; powdered alum, 4 grams; white sugar, 15 grams; distilled water, 120 c. c. Dissolve by heat, and when cool add alcohol sol. thymol (10%), 6 c. c.

15.—Soft gelatine, 40 grams; distilled water, 120 c. c.; allow to soak for 24 hours, and add chloral hydrate, 20 grams. Heat on a water bath till liquid, or for about an hour, and then neutralize with a few drops of solution of carbonate of soda.

16.—Pastes that liquefy on working up or teating usually consist of a jelly of isinglass or refined gelatine. The most satisfactory paste for use as a photograph mountant has the following composition: White dextrine, 8 oz.; water, heated to about 160° F., 12½ fl.oz.; oil of wintergreen, 3 drops; oil of cloves, 3 drops. Dissolve the dextrine in hot water by stirring, when cool add the oils, and stir until a smooth cream results. Pour the paste into suitable vessels—grass, wide-mouthed bottles, or porcelain jars—corks, and place in a cool place for about a week to allow the paste to congeal and ripen.

17.—Powdered starch, 3½ oz.; gelatine, 2 dr.; alcohol, 2 oz.; solution of formaldehyde (40%), 1 dr.; water, 30 oz. Soak and dissolve the gelatine in the water, heat to boiling, and pour, with constant stirring, on to the starch, previously mixed to a cream with a little cold water. When nearly cold add to the paste the formaldehyde solution. We think it likely that these pastes will be less adhesive than one made from flour, but, on the other hand, they probably have the advantage of being whiter, if very white gelatine be employed.

18.—*Non-Buckling Photographic Mountant.*—To prevent buckling when a print is mounted upon a thin support, the *Professional and Amateur Photographer* suggests the use of the following adhesive; (a) White shellac, 1 oz.; alcohol, 2 oz. (b) Mastic, dissolved in a little chloroform. Add a small proportion of (a) to (b) and apply to the print; allow it to "set" until it becomes a trifle "sticky," then place the print on the mount, and press.

19. *Photographs on Glass.*—a.—White gum acacia, ½ oz.; dextrine, 2¼ oz.; liquid ammonia, 4 drops; water, 8 oz. Crush the gum acacia to a powder in a mortar, mix in the dextrine, and then rub with 2 oz. of the water until smooth; add the remaining water and boil in an enameled saucepan for 10 minutes. When cold put into any suitable wide-mouthed bottle and add the ammonia. This mountant is said to be smooth as oil, easy to prepare, does not thicken, and will stick like glue.

b.—According to the *Werkstatt*, clean the inner hollow side of the glass thoroughly, pour on gelatine dissolve in boiling water, lay the picture on, and pour on gelatine again, so that everything swims. Then neatly remove what is superfluous, so that no blisters result, and allow to dry. The following recipe is said to be still better: Gelatine, by weight, 16 parts; glycerine, by weight, 1 part; water, by weight, 32 parts; methylic alcohol, by weight, 12 parts. The mixture is prepared by causing the gelatine to swell up in water, then dissolving it with the use of moderate heat, adding the glycerine, stirring thoroughly, and pouring the whole, in a thin stream, into the alcohol.

20.—*Transparent Glue* for glass, or glass paperweights, so that the photographs will show clearly through the glass. a.—White gelatine, 5 av.oz.; acetic acid, 5 fl.oz.; water, sufficient. Macerate the gelatine, which should be of the best quality, white and perfectly transparent, in 6 fl.oz. of water for 12 hours; heat the mixture on a water bath until the gelatine is dissolved; add to it the acetic acid, and then enough water to make 16 fl.oz.

b.—White gelatine, 4 av.oz.; white sugar, 2 av.oz.; water, sufficient. Macerate the gelatine with 10 fl.oz. of water overnight; heat the mixture until the gelatine is dissolved; add the sugar; strain through a muslin strainer, and add enough water to make 16 fl.oz.

WATERPROOF ADHESIVES.

Cements.

1.—Soak pure glue in water until it is soft, then dissolve it in the smallest possible amount of proof spirits by the aid of gentle heat. In 2 oz. of this mixture dissolve 10 grams of gum ammoniacum, and while still liquid add ½ dr. of mastic, dissolved in 3 dr. of rectified spirits. Stir well, and for use keep the cement liquefied in a covered vessel over a hot-water bath.

2.—A good waterproof cement may be made by mixing 5 parts of glue, 4 parts of rosin and 3 parts of red ocher with a little water.

3.—Shellac, 4 oz.; borax, 1 oz.; boil in a little water until dissolved, and concentrate by heat to a paste.

4.—Carbon bisulphide, 10 parts, and oil of turpentine, 1 part, are mixed, and as much gutta percha is added as will readily dissolve.

5.—Tar, 1 part; tallow, 1 part; fine brick dust, 1 part; the latter is warmed over a very gentle fire; the tallow is added, then the brick dust, and the whole is thoroughly mixed. It must be applied while hot.

6.—Good gray clay, 4 parts; black oxide of manganese, 6 parts; limestone, reduced to powder by sprinkling it with water, 90 parts; mixed, calcined, and powdered.

7.—Manganese iron ore, 15 parts; lime, 85 parts; calcined and powdered.

Both 6 and 7 require to be mixed with a little sand for use; brown into water, they harden rapidly.

8.—Fine, clean sand, 1 cwt.; powdered quicklime, 28 lb.; bone ash, 14 lb. Beaten up with water for use.

9.—Quicklime, 5 parts; fresh cheese, 6 parts; water, 1 part. The lime is slaked by sprinkling with the water; thereupon it is passed through a sieve, and the fresh cheese is added. The latter is prepared by curdling milk with a little vinegar and removing the whey. The cement thus formed is very strong, but it requires to be applied immediately, as it sets very quickly.

10.—Fresh curd, as before, 1 part; quicklime, 1 part; Roman cement, 3 parts. Used for joining stone, metals, wood, etc.

11.—A paste composed of hydraulic lime and soluble glass.

12.—Glue, 1 part; black rosin, 1 part; red ocher, ¼ part; mixed with least possible quantity of water.

13.—Glue, 4 parts; boiled oil, by weight, 1 part; oxide of iron, 1 part.

14.—Mix a handful of quicklime with 4 oz. of linseed oil; thoroughly lixiviate the mixture, boil it to a good thickness, and spread it on the plates, in the shade. It will become very hard, but it can be dissolve over a fire, like common glue, and is then fit for use.

15.—Bichromate of potash, by weight, 8 parts; gelatine size, by weight, 11 parts; alum, by weight, 1 part. Dissolve the gelatine in a little water, then add the bichromate of potash and the alum. This glue or cement resits water at all temperatures.

16.—A cement to stop cracks in glass vessels, to resist moisture and heat, is made by dissolving casein in a cold saturated solution of borax. With this solution paste strips of hog's or bullock's bladder, softened in water, on the cracks of glass, and dry at a gentle heat. If the vessel is to be heated, coat the bladder on the outside, just before it has become quite dry, with a paste of a rather concentrated solution of soda and quicklime or plaster of paris.

17.—A very valuable cement has been discovered by Mr. A. C. Fox, of which details are published in *Dingler's Polytechnisches Journal*. It consists of a chromium preparation and isinglass, and forms a solid cement, which is not only insoluble in hot and cold water, but even in steam, while neither acids nor alkalies have any action upon it. The chromium preparation and the isinglass or gelatine do not come into contact until the cement is desired, and when applied to adhesive envelopes, for which the author holds it to be especially adapted, the one material is put on the envelope covered by the flap (and, therefore, not touched by the tongue), while the isinglass, dissolved in acetic acid, is applied under the flap. The chromium preparation is made by dissolving crystallized chromic acid in water. Take crystallized chromic acid, 2.5 grams; water, 15 grams; ammonia, 15 grams. To this solution add 10 drops of sulphuric acid and 30 grams of sulphate of ammonia and 4 grams of fine white paper. In the case of envelopes, this is applied to that portion lying under the flap, while a solution prepared by dissolving isinglass in dilute acetic acid (1 part acid to 7 parts water) is applied to the flap of the envelope. The latter is moistened, and then is pressed down upon the chromic preparation, when the two unite, forming a firm and insoluble cement.

18.—*Glass, Stoneware and Metal.*—a.—Make a paste of sulphur and sal ammoniac, iron filings and boiled oil.

b.—Mix together dry: Whiting, 6 lb.; plaster of paris, 3 lb.; sand, 3 lb.; litharge, 3 lb.; rosin, 1 lb. Make to a paste with copal varnish.

c.—Make a paste of boiled oil, 6 lb.; copal, 6 lb.; litharge, 2 lb.; white lead, 1 lb.

d.—Make a paste with boiled oil, 3 lb.; brick dust, 2 lb.; dry slaked lime, 1 lb.

e.—Dissolve 93 oz. of alum and 93 oz. of sugar of lead in water to concentration. Dissolve separately 152 oz. of gum arabic in 25 gal. of water, and then stir in 62½ lb. of flour. Then heat to a uniform paste with the metallic salts, but take care not to boil the mass.

f.—For iron and marble to stand in heat.—In 3 lb. of water dissolve first 1 lb. of water glass, and then 1 lb. of borax. With the solution make 2 lb. of clay and 1 lb. of barytes, first mixed dry, to a paste.

19.—*Impervious Cement.*—Use zinc white, rubbed up with copal varnish.

20.—*Water, Acid, Oil Resisting.*—Simple shellac, made into sticks of the size of a lead pencil. The objects to be cemented are first warmed till they melt the shellac brought in contact with them. This is very good to cement broken glass, porcelain, etc., especially as the objects are again ready for use immediately when cold; but it is not adapted for flexible objects, as it cracks, and also will not withstand heat or alcohol.

21.—*White-Lead Cement, Withstanding Heat and Moisture.*—Pure white lead, or zinc white, ground in oil, and used very thick, is an excellent cement for mending broken crockery ware, but it takes a very long time to harden. It is well to put the mended object in some storeroom, and not to look after it for several weeks, or even months. It will then be found so firmly united that, if ever again broken, it will not part on the line of the former fracture.

Glues.

1.—Glue, 1 part; black rosin, 1 part; red ocher, ¼ part; mix with the least possible quantity of water. Or: Glue, 4 parts; boiled oil, by weight, 1 part; oxide of iron, 1 part.

2.—Glue, 1 lb., melted with the least quantity of water, and then mixed with black rosin, 1 lb., and red ocher, 4 oz.

3.—Glue, melted as above, and mixed with about ¼ of its weight each of boiled oil and red ocher.

4.—*Ure.*—Melted glue (of the consistency used by carpenters), 8 parts; linseed oil, boiled to varnish, with litharge, 4 parts; incorporate thoroughly together.

5.—Glue (melted as last), 4 parts; Venice turpentine, 1 part.

The first three dry in about 48 hours, and are very useful to render the joints of wooden casks, cisterns, etc., watertight; also to fix stones in frames. The last serves to cement glass, wood, and even metal, to each other. A good cement for fixing wood to glass may be made by dissolving isinglass in acetic acid, in such quantities that it becomes solid when cold. When applied let it be heated. They all resist moisture well.

6.—Dissolve 16 oz. of glue in 3 pt. of skim milk. If a still stronger glue be wanted, add powdered lime.

7.—Dissolve sandarac and mastic, of each 231 gr., in 1 pt. of alcohol mixed with 231 gr. of turpentine, and heated to boiling. Add the solution gradually to a hot concentrated solution of equal parts of glue and isinglass, stirring meanwhile, and until a thin paste is formed that can be filtered and used like ordinary glue.

8.—Glue may be rendered insoluble by tannic acid dissolved in a small quantity of soft water.

9.—In order to render glue insoluble in water, even hot water, it is only necessary, when dissolving the glue for use, to add a little potassium bichromate to the water and to expose the glued part to the light. The proportion of potassium bichromate will vary with circumstances, but for most purposes about 1-50 of the amount of glue used will suffice. In other words, glue containing potassium bichromate when exposed to the light, becomes insoluble.

10.—To make an impermeable glue, soak ordinary glue in water until it softens, and remove it before it has lost its primitive form. After this dissolve it in linseed oil over a slow fire until it is brought to the consistency of a jelly. This glue may be used for joining any kinds of material. In addition to strength and hardness, it has the advantage of resisting the action of water.—*Revue Industrielle.*

11.—*Cardboard.*—Melt together equal parts of good pitch and gutta percha; of this take 9 parts, and add to it 3 parts of boiled linseed oil and 1½ parts of litharge. Place this over the fire and stir till all the ingredients are intimately mixed. It may be diluted with a little benzine or oil of turpentine, and must be warm when used.

12.—*Fire and Waterproof Glue.*—a.—Mix a handful of quicklime with 4 oz. of linseed oil; thoroughly lixiviate the mixture. Boil until quite thick, and spread on tin plates. It will become very hard, but can be dissolved over a fire like common glue.

b.—Mix a handful of quicklime in ¼ lb. of linseed oil; boil them to a good thickness, and then spread it on a slab to cool.

13.—*Wood.*—a.—Very thick solution of glue, 100 parts; linseed-oil varnish, 50 parts; litharge, 10 parts. Boil for 10 minutes, and use while hot.

b.—These is no glue for wood which must be kept in contact with water that is better than bichromated glue. Allow it to harden thoroughly.

c.—Liquid glue for wood and iron is made, according to Hesz, as follows: Clear gelatine, 100 parts; cabinetmakers' glue, 100 parts; alcohol, 25 parts; alum, 2 parts; the whole mixed with 200 parts of 20% acetic acid and heated in a water bath for 6 hours.

d.—An ordinary glue for wood and iron is made by boiling together for several hours 100 parts glue, 260 parts water, and of the weather.

e.—Waterproof glue may be made by boiling 1 lb. of common glue in 2 qt. of skim milk. This withstands the action of the weather.

f.—Glue, 12 parts; water, q. s. to dissolve; add yellow rosin, 3 parts, and when melted, turpentine, 4 parts; mix thoroughly together in a water bath.

g.—Glue Which Stands Moisture Without Softening.—Dissolve in 8 fl.oz. of strong methylated spirit, ½ oz. each of sandarac and mastic; next add ½ oz. of turpentine. This solution is then added to a hot, thick solution of glue to which isinglass has been added, and is next filtered, while hot, through cloth or a sieve.

Paste.

1.—The following formula is intended to resist water, cold or hot, and is also unaffected by alcohol or acids: Chromic acid, 2½ parts; stronger ammonia, 15 parts; sulphuric acid, ½ part; cuprammonium solution, 30 parts; fine white paper, 4 parts.

2.—Isinglass, a sufficient quantity; acetic acid, 1 part; water, 7 parts. Dissolve sufficient isinglass in the mixture of acetic acid and water to make a thin mucilage. One of the solutions is applied to the surface of one sheet of paper and the other to the other sheet, and they are then pressed together.

3.—Prepare a paste of good rye flour and glue, to which linseed-oil varnish and turpentine have been added in the proportion of ½ oz. each to the pound.

Putty.

Cement for petroleum lamps, panes in aquariums, knife handles that have become loose, as well as for any other waterproof closure, is produced from litharge and glycerine. The former must be as finely powdered as possible, and the glycerine very condensed, of a syrupy consistency, and limpid. Mix the two ingredients into a semi-liquid paste, coat the places, or pour the tough mass into the respective cavity, and press into it the part to be cemented on, such as a knife blade or petroleum fount. The surplus oozing out must be removed at once and the place cleaned, as the putty hardens very rapidly. For the same reason it is advisable to preserve the ingredients separately and to mix no more of the material than is required at the time. No subsequent loosening or giving need be feared; this cement has the advantage of great simplicity.

CHAPTER VII

CLEANSING, BLEACHING, RENOVATING AND PROTECTING

This section deals with the removal of spots and stains on fabrics, leather, straw, paper, paint, walls, stone, metal, rust prevention and removal, etc. The scope of the subject is very wide, and deals with many household troubles and labors, such as laundry work.

The arrangement is alphabetical, but as it was frequently necessary to choose between the name of a fabric, for instance, and the name of a stain, or a cleansing agent that was not limited in usefulness, it will be necessary to consult the *Index* for references to necessarily scattered formulas.*

The following books are recommended for technical and detailed information on this subject: Pawlie, "Practical Handbook of Germent Dyeing and Cleaning," $3.75; Farrell, "Dyeing and Cleaning, a Practical Handbook," $1.75; Brannt, "Practical Dry Cleaner, Scourer and Garment Dyer," $2.50.

Acid Stains.

1.—Chloroform will restore the color of garments where the same has been destroyed by acids. See No. 2.

2.—When acid has accidentally or otherwise destroyed or changed the color of the fabric, ammonia should be applied to neutralize the acid. A subsequent application of chloroform restores the original color.

3.—Spots produced by hydrochloric or sulphuric acid can be removed by the application of concentrated ammonia, while spots from nitric acid can scarcely be obliterated.

4.—*Acids, Vinegar, Sour Wine, Must, Sour Fruits.*—White goods, simple washing, followed up by chlorine water if a fruit color accompanies the acid. Colored cottons, woolens and silks are very carefully moistened with dilute ammonia with the finger end. In the case of delicate colors it will be found preferable to make some prepared chalk into a thin paste with water, and apply it to the spots.

5.—*Picric Acid Spots.*—Removal from the hands or linen is, according to Prieur, effected by rubbing them with a paste of lithium carbonate and water.

Alabaster.

1.—The best method of cleaning these ornaments is to immerse them for some time in milk of lime, and then wash in clean water, and when dry dust them with a little French chalk. Milk of lime is made by mixing a little slaked lime in water. This has a "milky" appearance, whence its name. Benzol or pure oil of turpentine are very highly recommended.

2.—Use soap and water, with a little washing soda or ammonia, if necessary. Rinse it thoroughly.

Alizarine Inks.

White goods, tartaric acid, the more concentrated the older are the spots. On colored cottons and woolens, and on silks, dilute tartaric acid is applied cautiously.

Alkali Stains.

1.—A mixture of acetic acid, diluted with a large quantity of water, will remove stains brought by soda, soap, boilers, lye, etc., if the solution is readily applied.

2.—On white goods, simple washing in water. On dyed tissues of cotton and wool, and on silk, weak nitric acid, poured drop by drop, and rub with the finger the spot previously moistened.

Aluminum.

Cleansing Fluid.—A solution of 30 grams of borax in 1 l. of water containing a few drops of aqua ammonia.

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*Dry cleaning is not treated in this book, as it requires special machinery and methods, as well as great technical skill.

Discoloration, Removing.—It is necessary simply to remove the foreign matter, . and, fortunately, this can be very easily done. One way is to boil green fruits, particularly rhubarb, in a vessel. Another is to allow an oxalic acid solution—1 heaping teaspoonful of oxalic acid crystals to 1 gal. of lukewarm water—to stand in it overnight; then wash out the utensil thoroughly with clear hot water, rinse, and use as accustomed. But more to the point is the fact that, although a discolored utensil is unsightly in appearance, there is no danger whatever in using it. In other words, the impurities form no poisonous compound with the aluminum.

Prlish.—1.—Aluminum is susceptible of taking a beautiful polish. This, unfortunately, is not white, like that of silver or nickel, but slightly bluish, like tin. The shade can be improved. First, the grease is to be removed from the object with pumice stone; then, for polishing, use is made of an emery paste mingled with tallow, forming cakes, which are rubbed on the polishing brushes. Finally, red rouge is employed with oil of turpentine.

2.—Stearic acid, 1 part; fuller's earth, 1 part; tripoli, 6 parts. To give the aluminum a natural, pure white color, dip it into a strong solution of caustic soda or potassa, and then into a bath of 2 parts of nitric acid and 1 part of sulphuric acid; thence into pure nitric acid, and finally into vinegar diluted with water. Rinse in running water, and dry in hot sawdust. Burnish with a bloodstone burnisher.

Ammonia. (For toilet ammonia see TOILET PREPARATIONS.)

Various formulas for household ammonia and kindred preparations have been published from time to time. Household ammonia is simply diluted ammonia water to which borax and soap have been added. To make it cloudy add potassium nitrate or alcohol.

1.—Soft soap, 1 oz.; borax, 2 dr.; eau de cologne, ½ oz.; stronger water of ammonia, 5½ oz.; water enough to make 12 oz. Rub up soap and borax with water until dissolved, strain, and add the other ingredients.

2.—Sodium carbonate, 20 oz.; water of ammonia, 48 oz.; water, 32 oz. Mix. Allow to stand 2 or 3 days, and then decant the clear solution, and bottle.

3.—The following formulas yield a cloudy preparation: Potassium carbonate, 1 part; borax, 1 part; green soap, 1½ parts; strong water of ammonia, 4 parts; distilled water, 8 parts. Heat the water and dissolve in it the soap and potassium carbonate; then add the borax, and, when cold, the stronger water of ammonia. The preparation may be perfumed with the oil of mirbane.

4.—Ammonia water, 1 gal.; soft water, 8 gal.; yellow soap, 4 lb.; saltpeter, 8 oz. Cut the yellow soap in shavings, and dissolve in soft water by heating; add the saltpeter, and stir well until dissolved; strain, let settle, skim off all soap suds, etc., add the ammonia, and bottle at once.

5.—Perfumed ammonia scouring water is prepared by mixing spirits of sal ammoniac, 160 parts; finely scraped soap, 30 parts; borax, 10 parts; cologne water, 15 parts; distilled water, enough to make 460 parts of liquid.

6.—Yellow soap, 10 grains; borax, 1 dr.; lavender water, 20 minims; stronger ammonia water, 6 oz.; water enough to make 20 oz. Dissolve the soap and borax in 5 oz. of boiling water; when cold, add the lavender water and ammonia, and make up to a pint with water.

7.—Alcohol, 1 gal.; soft water, 1 gal.; stronger ammonia water, 1 gal.

8.—Ammonia water, 5 pt.; distilled water, 5 pt.; soap, 100 gr.; olive oil, 5 dr. Cut the soap in shavings, boil with the oil and water; cool, add the ammonia water, and bottle. For use in laundries, baths and general household purposes, add 1 tablespoonful to 1 gal. of water.

9.—Oleic acid, 1 oz.; alcohol, 1 oz.; ammonia water, 7 oz.; water to make 1 pt.

10.—Soap, in shavings, 2 oz.; potash lye, 1 oz.; ammonia water, 2 pt. A little alcohol is sometimes added to make the mixture clear.

11.—Ammonia water, 16 parts; yellow soap, 64 parts; potassium nitrate, 1 part; soft water, sufficient to make 200 parts. Shave up the soap and dissolve it in the water by heating; add the potassium nitrate, and dissolve. Let it cool, strain, skim off any suds or bubbles, add the ammonia, mix, and bottle at once.

12.—The best quality: Alcohol, 94%, 4 oz.; soft water, 4 gal.; oil of rosemary, 4 dr.; oil of citronella, 3 dr. Dissolve the oils in the alcohol and add to the water. To the mixture add 4 oz. of talc (or fuller's earth will answer), mix thoroughly, strain through canvas, and to the colate add 1, 2 or 3 gal. of ammonia water, according to the strength desired.

in which has been dissolved 1, 2 or 3 oz. of white curd or soft soap.

13.—"Ivory" soap (or other good white soap), 4 oz.; rain water, 4 pt.; 16° ammonia water, 4 pt. Cut or shave the soap fine and dissolve it in the water by the aid of heat; then cool, and add the ammonia. If other strength of ammonia water is used, make it correspond with the 16°; for example, if the U. S. 10° is used, take only 2 pt. of water instead of 4 pt., and use 6 pt. of ammonia water; if 20° ammonia is used, use 5 pt. of water and 3 pt. of ammonia water. This is sometimes called "white ammonia."

14.—Potassium carbonate, 1 oz.; rain water, 4 pt.; ammonia water, 4 pt. Dissolve the potassium carbonate (sal tartar) in the water and add the ammonia water.

Aniline Stains.

Sodium nitrate, 7 gr.; diluted sulphuric acid, 15 gr.; water, 1 oz. Let the mixture stand a day or two before using. Apply to the spot with a sponge, and rinse the goods with plenty of water.

Animal Fibers, Bleaching.

The material, freed from sweat, fat, gum, etc., is placed in a bath in which a little finely ground indigo (½ part to 1 part in 100,000 parts of water) is suspended. Then the spun fibers are placed from 24 to 48 hours in an aqueous solution of hydrosulphite of sodium, to which acetic acid has been added. To each 1,000 parts of the 1 to 4° B. solution take 5 to 20 parts of 50% acetic acid, expose to air, then wash, first in a weak soda solution, then in clear water, and finally dry at 86 to 95° F.

Animal Glue, Bleaching. (Muzzarelli.)

Add to fine white glue prepared from rabbit skins, for dressing white tissues, a small quantity of sulphate of soda, and mix well; acetate of lead is then added, whereby a precipitate of sulphate of lead is occasioned; the resulting jelly is thus blanched, and, after cooling, is cut up and dried as usual.

Animals, Stuffed.

Give the animal a good brushing with a stiff clothes brush. After this warm a quantity of new bran in a pan, taking care it does not burn, to prevent which quickly stir it. When warm, rub it well into the fur with your hand. Repeat this a few times, then rid the fur of the bran, and give it another sharp brushing until free from dust.

Balances.

Equal parts of oleic acid, water of ammonia and absolute alcohol are mixed, and filtered after settling. The articles to be cleaned are rubbed with the mixture by means of a cloth, and polished with a little powdered tripoli.

Barometer Tubes.

Try a small quantity of warm nitric acid. Then rinse with water, rinse with absolute alcohol, and finally with ether; warm to expel the vapor of ether.

Beeswax, To Bleach.

Pure white wax is obtained from the ordinary beeswax by exposure to the influence of the sun and weather. The wax is sliced into thin flakes and laid on sacking or coarse cloth, stretched on frames, resting on posts to raise them from the ground. The wax is turned over frequently, and occasionally sprinkled with soft water if there be not dew and rain sufficient to moisten it. The wax should be bleached in about 4 weeks. If, on breaking the flakes, he wax still appears yellow inside, it is necessary to melt it again, and flake and expose it a second time, or even oftener, before it becomes thoroughly bleached, the time required being mainly dependent upan the weather. There is a preliminary process, by which, it is claimed, much time is saved in the subsequent bleaching. This consists in passing melted wax and steam through long pipes, so as to expose the wax as much as possible to the action of the steam; thence into a pan heated by a steam bath, where it is stirred thoroughly with water, and then allowed to settle. The whole operation is repeated a second and third time, and the wax is then in condition to be more readily bleached.

Benzine and Gasoline Preparations.

In handling benzine and gasoline, and products into which they enter, their great inflammability should never be lost sight of.

1.—The following is said to be the composition of a preparation that will solidify benzine: Cocoanut-oil soap, 2 oz.; solution of potassium hydroxide, 1½ oz.; ammonia water, 3 oz.; water, enough to make 12 oz. Dissolve the soap in about 4 oz. of hot water, add the alkalis and the remainder of the water. If the benzine be added in small portions, with thorough agitation, 2½ oz. of this mixture will solidify 32 oz. of benzine.

2.—Strong ammonia water, 20 parts; tincture of quillaya (20%), 30 parts; other, 30 parts; benzine, 150 parts; alcohol, 500 parts.

3.—a.—Solidified gasoline or benzine jelly may be made as follows: Tincture of soap bark, 12 fl.dr.; benzine to make 8 fl.oz. Mix, and shake for ½ hour, then allow to stand 12 hours to solidify.

b.—Infusion of soap bark (20%), 4 fl.dr.; benzine, 2 fl.oz.; proceed as above.

c.—White soap, 120 grams, dissolved in 180 grams of hot water in a liter bottle, and 30 grams of ammonia added. The solution is then made up to ¾ of the bottle by water, and shaken up. A teaspoonful of this mixture is placed in a bottle holding 250 grams, and mixed therein with some benzine, and afterward the bottle is filled with benzine under protracted shaking.

4.—White Castile soap, 3½ av.oz.; boiling water, 3½ fl.oz.; water of ammonia, 5 fl.dr.; benzine, enough to make 16 fl.oz. Dissolve the soap in the water, and, when cold, add the other ingredients.

5.—*Incombustible Benzines and Ethers.* a.—For rendering ethers and benzines incombustible a method is to add carbon tetrachloride in suitable proportions. This is a slightly volatile body, which can be dissolved cold in ethers, alcohols, and other products. For benzine, absolute incombustibility is said to be secured with 25 or 30% of the tetrachloride. The result of numerous experiments shows that ignited benzine is extinguished if carbon tetrachloride is poured on the flames; it acts by solution in the benzine, and there is, therefore, the possibility of using the tetrachloride as an extinguisher of fire. For this purpose it may be either enclosed in grenades of thin glass, to be thrown on the fire, or, as in the Decrut method, directly projected by means of a pump. This is the composition of a much advertised cleaning medium which has a very extensive sale.

b.—Rosin soap, 1 lb.; common white soap, 1 lb.; potassium hydroxide, 3 oz.; alcohol, 8 oz.; carbon tetrachloride, 5 pt.; enough water. Melt the soaps together on a water bath, adding them a little water from time to time as required. Dissolve the potassium hydroxide in the alcohol, add to this solution 1½ pt. of carbon tetrachloride and incorporate the liquid in the soap mass, beating the whole with an egg beater. Transfer the pasty mass to a suitable bottle, add the rest of the carbon tetrachloride and mix the whole by agitation. The compound should at once be transferred to wide-mouthed bottles of the size desired for the market and these immediately corked tightly. Sometimes a portion of the carbon tetrachloride separates from the "cream" on standing, but it can be reincorporated quite easily by shaking before using.

Birds. (See **Feathers and Birds.**)

Black Cloth.

Dissolve 1 oz. of bicarbonate of ammonia in 1 qt. of warm water. With this liquid rub the cloth, using a piece of flannel or black cloth for the purpose. After the application of this solution clean the cloth well with clear water, dry, and iron it, brushing the cloth from time to time in the direction of the fiber.

Blackboards, To Remove Grease from.

Make a strong lye of pearlashes and soft water, and add as much unslaked lime as it will take up. Stir it together and let it settle a few minutes; bottle it, and stopper close. Have ready some water to dilute it when used, and scour the part with it. The liquor must not remain long on the board, as it will draw the color with it. Hence use it with care and expedition.

Blankets.

1.—Put 2 large tablespoonfuls of borax and 1 pt. of soft soap into a tub of cold water. When dissolved put in a pair of blankets and let them remain overnight. Next day rub, and drain them out, and rinse thoroughly in two waters, and hang them up to dry. Do not wring them.

2.—Scrape 1 lb. of soda soap and boil it down in sufficient water so that when cooling you can beat it with the hand to make a sort of jelly. Add 3 tablespoonfuls of spirit of turpentine and 1 tablespoonful of spirit of hartshorn, and with this wash the article well and rinse in cold water until all the soap is taken off. Then apply salt and water, and fold between two sheets, taking care not to allow two folds of the article washed to tie together. Smooth with a cool iron. Only use the salt where there are delicate colors that may run. If you can get potash soap, it will be better, as woolen manufacturers do not use soda soap.

3.—Put the soiled blankets to soap for 15 minutes in plain soft warm water. Prepare a soft jelly with first-class laundry soap and boiling water, 1 lb. of soap for every blanket. Pour this into a tub of warm water, let it melt, and lather it up well with the hand. Wring the blankets from the soaking tub, and throw them into the lather; stir them about, and leave to soak for 10 mnutes; then hand-rub every inch of the blankets, paying especial attention to stains. Take them out and wring, then rinse in warm water twice. Dry well, but do not expose them to great heat. When dry, stretch them in every direction, and rub all over with a piece of clean rough flannel. This makes them fluffy and soft. If very dirty, a little borax may be added to the water, but no soda or bleaching powder should ever be used.

Bleaching.

1.—*Bleaching Powder, or Chloride of Lime*, is prepared by passing chlorine gas into boxes of lead in which a quantity of slaked lime is laid on shelves. The stuff to be bleached is first boiled in lime water; wash, and, withoutt drying, boil again in a solution of soda or potash; wash, and, without drying, steep in a weak mixture of chloride of lime and water for 6 hours; wash, and, without drying steep for 4 hours in a weak solution or mixture of sulphuric acid and water; wash well, and dry; upon an emergency, chlorate of potash, mixed with 3 times its weight of common salt, and diluted in water, may be used as a bleaching liquid.

2.—Carbonate of potash, 22 parts; sand, free from alumina and iron, 30 parts; charcoal, 2 parts.

3.—Carbonate of soda, 22 parts; carbonate of potash, 70 parts; silicate of potash, 20 parts; charcoal, 1 part.

4.—Silica, 1 part; common salt, 2 parts.

5.—The remarkable bleaching compound of Mr. Charles Toppan, of Salem, Mass., consists of 3 parts, by measure, of mustard-seed oil, 4 parts of melted paraffine, and 3 parts of caustic soda, 20° Be., well mixed to form a saponaceous compound. Of this, 1 part of weight and 2 parts of pure tallow soap are mixed, and of this mixture 1 oz. for each gal. of water is used for the bleaching bath, and 1 oz. of caustic soda, 20° Be., for each gal., is added, when the bath is heated in a close vessel, the goods entered, and boiled "until Sufficiently bleached."

6.—*Delicate Fabrics.*—The goods must be washed and boiled, then transferred to a warm bath of 300 parts of water and 2 parts of permanganate of potash. In this it must be left for an hour, always under water. It is then transferred to the second cold bath of 500 parts of water with 50 parts of sulphurous acid, in which it must remain covered for 3 to 4 hours. To be then dried in a warm place.

7.—*Instantaneous Bleaching Fluid.*—In 5½ pt. of water, heated to 190 or 212° F., are introduced successively: Mother of pearl, 3½ oz.; indigo, 0.75 gr.; cochineal, 0.75 gr.; chloride of lime, 150 gr.; soda crystals, 150 gr.; potash, 150 gr. Boil for half an hour, and the preparation is ready for use. The inventor, M. Boiseller, says: "The mother of pearl gives softness, luster, suppleness, etc., and gives to hemp the feel of cashmere; the indigo gives a slight azure tint, the cochineal adds brightness, the chloride effects the bleaching, the soda washes and brushes, and the potash removes all grease."

8.—*Small Articles.*—Articles, as pocket handkerchiefs, require, every few weeks, to get a good "stewing" in a warm oven, often having to be left there, in a good large stewpan, for several days at a time, until they look white. As a preparation for washing, always steep white (not color-pinted ones) articles in cold water for a few hours, and then the soiled parts can be very much cleansed by a good pressing together between the hands—no violent rubbing—then use good white soap on them, and let them remain overnight, folded flat in a dish, not in water, but yet wet enough to completely melt the soap through the texture of the articles. Do not be stingy of soap; you can use the lather with other articles of a less fine sort. A little practice will bring you to the use of enough without waste. Next day pour on to said clothes a kettleful of very clean boiling water—boiling, mind you; for if only 1° below the boiling point it will not be hot enough to whiten them. Cover your washing mug (or basin) at once, so that the steam is kept in; after 20 to 30 minutes has passed wash your things, and give them a rinse in plenty of tepid water. If now they are not to your satisfaction, spread them, well pulled out, while wet, upon a large dish, which place at or outside an open, sunny window, sprinkle them with clean cold water several times a day. Keep this going for 2 or 3 days; then wash again in a clean "scald," as above described, and when you have them finished it will be your own fault if your laces and handkerchiefs are not a wonder to all beholders. Never starch your lace articles, but crip them in cold water in which 2 or 3 lumps of loaf sugar are dissolved; also, be sure to stretch out the work while wet, then dry flat on a towel upon the bed.

Blood Stains.

1.—An accidental prick of the finger frequently spoils the appearance of work, and if for sale, decreases its value. Stains may be entirely obliterated from almost any substance by laying a thick coating of common starch over the place. The starch is to be mixed as if for the laundry, and laid on quite wet.

2.—The free and early application of a weak solution of soda or potash, and the subsequent application of the solution of alum, is recommended.

3.—*Blood and Albuminoid Matters.*—Steeping in lukewarm water. If pepsine, or the juice of the *Carica papaya*, can be procured, the spots are first softened with lukewarm water, and then either of these substances is applied.

Books.

1.—*Blood Stains.*—Soak in cold water, wash with soap, and rinse.

2.—*Damp* stains are treated in the same way as water stains, but with less chance of success.

3.—*Dust* can be removed by using bread or very soft rubber.

4.—*Finger Marks.*—Very difficult to erase. Apply a jelly of white or curd soap, then wash with a brush in cold water.

5.—*Fox Marks.*—Use very dilute hydrochloric acid or Javelle water.

6.—*Grease Spots.*—a.—Put over the spot a piece of blotting paper and apply a hot iron.

b.—Or, apply French chalk, put a piece of paper over it, and apply the iron.

c.—Or, try ether or benzine, put blotting paper above and below the spot.

7.—*Ink Stains (Marking Ink, etc.).*—Apply tincture of iodine. The silver in the ink forms silver iodine, which is removed by a weak solution of potassium cyanide (deadly poison).

8.—*Ink Stains (of Writing Ink).*—Usually try oxalic acid followed by chloride of lime. Wash well.

9.—*Mud.*—Very little can be done. Wash in cold water, then in dilute hydrochloric acid, and afterward in a weak solution of chloride of lime. Rinse, and dry.

10.—*Water* stains are removed by boiling water and alum. It will be necessary to float the sheet on this bath for some hours. Dry between clean blotting paper. The amount of alum is immaterial.

1.—Oil or fatty matter may be easily removed by a solution of permanganate of potassa.

2.—To remove turpentine, petroleum, photogene, etc., pour into them a little strong sulphuric acid; after they have been allowed to drain as much as possible the bottle is then corked, and the acid caused to flow into every portion of it, for about 5 minutes. It is then washed with repeated rinsings of cold water. All traces of oil or grease left will be removed in a very expeditious manner, and no odor whatever will be left in the bottle after washing.

3.—Introduce 2 heaped tablespoonfuls (for every quart of capacity) of fine sawdust or wheat bran, and shake well to cover the interior surface thoroughly; let stand a few minutes, and then add about 100 c. c. of cold water. If the bottle be then rotated in a horizontal position it will usually be found clean after a single treatment. In the case of drying oils, especially when old, the bottles should be moistened inside wth a little other, and left standing a few hours before the introduction of sawdust. This method is claimed to be more rapid and convenient than the customary one of using strips of paper, soap solution, etc.

4.—Where soda and water does not do the work, put about equal parts of powdered potassium bichromate and sulphuric acid into the bottle. Shake the bottle well until the particles turn black, then rinse out well with water.

5.—If vessels are oily, or otherwise greasy, they should not be washed with water, but wiped with dry tow, or a dry dirty cloth, so as to remove as much grease as possible. By changing the cloth for one that is clean, the vessel can be wiped until all traces of grease disappear.

6.—A strong solution of an alkali, such as pearlash, may be used, whereby the removal of the grease is materially facilitated.

7.—It would be easy for a practical brush maker to construct a brush in the form of a hollow cone, which would reach the bottom of bottles; but the difficulty would be to get it into the bottle without spoiling it (the brush.) A brush composed of a single bundle of long hairs, something like a painter's sash tool, with the bristles cut somewhat tapering, should answer the purpose. The bottle must, of course, be turned around with the hand, to bring every part into contact with the brush.

8.—Lead shot, where so used, often leave carbonate of lead on the internal surface, and this is apt to be dissolved in the wine or other liquids afterward intrduced, with poisonous results; and particles of the shot are sometimes inadvertently left in the bottle. Fordos states that clippings of iron wire are a better. means of rinsing. They are easily had. and the cleaning is rapid and complete. The iron is attacked by the oxygen of the air, but the ferruginous compound does not attach to the side of the bottle, and is easily removed in washing. Besides, a little oxidized iron is not injurious to health. Fordos found that the small traces of iron left had no apparent effect on the color of red wines; it had on white wines, but very little; but he thinks it might be better to use clippings of tin for the latter.

9.—Take a small piece of the very finest and softest flannel, without crease or seam, or a few inches of superfine broadcloth, dip this in powder blue, and with it clean your plate glass, polishing with a rag of soft silk or fine chamois leather.

10.—To remove some odors in bottles has baffled almost all attempts of druggists to counteract or dissipate them. Iodoform, asafetida, ichthyol and valerian are among the articles which furnish these persistent odors. Fresh powdered mustard poured into the bottle (*Sud. Apoth. Zeit.*), followed by cold water, agitation, short standing, and a final rinsing, will clear them of the offending odors.

11.—*Rosin, Turpentine, Resinous Varnishes, etc.*—a.—Wash with a strong alkaline solution, and rub by means of wire and tow.

b.—If the alkali fails to act, a little sulphuri acid may be employed with advantage. The latter acid will also be found advantageous in removing pitch and tar from vessels of glass. Nitric or sulphuric acids may be employed to clean flasks which have contained oil.

12.—*Rubber Stoppers.*—Cover the stoppers with water, add a few ounces of burnt sugar, and let them soak for a few days, stirring onces or twice daily. After this treatment wash them, and they are ready for use.

Brass and Copper Cleaning. (See also **Gas Fixtures.**)

1.—There are many substances and mixtures which will clean brass. Oxalic acid, muriatic acid, and several other acids, will clean brass very effectively; oxalic acid is the best, but the acids must be well washed off, the brass dried, and then rubbed with sweet oil and tripoli, otherwise it will soon tarnish again. Mixture to clean brass is: Soft soap, 1 oz.; rotten stone, 2 oz.

2.—Oxalic acid, 1 oz.; rotten stone, 2 oz.; sweet oil, 1½ oz.; spirits of turpentine, enough to make a paste. When used, a little water is added, and friction applied. If the brass is very dirty it requires a strong acid to make it bright; such is chromic acid, best prepared by mixing bichromate of potassa, sulphuric acid and water, equal parts of each. This makes the dirtiest brass bright and clear at once, but it must be immediately washed off with plenty of water, rubbed dry, and polished with rotten stone. There are no patents on any of those preceedings, and if there were, the patentees would not be sustained in their claims.

3.—Wash with rock alum, boiled in a strong lye in the proportion of 1 oz. to 1 pt.; polish with dry tripoli.

4.—The government method prescribed for cleaning brass, and in use at all the United States arsenals, is claimed to be the best in the world. The plan is to make a mixture of 1 part of common nitric acid and ½ part of sulphuric acid, in a stone jar, having also ready a pail of fresh water and a box of sawdust. The articles to be treated are dipped into the acid, then removed into the water, and finally rubbed with sawdust. This immediately changes them to a brilliant color. If the brass has become greasy it is first dipped in a strong solution of potash and soda in warm water; this cuts the grease, so that the acid has free power to act.

5.—Rub the surface of the metal with rotten stone and sweet oil, then rub rub off with a piece of cotton flannel, and polish with soft leather. A solution of oxalic acid rubbed over tarnished brass soon removes the tarnish, rendering the metal bright. The acid must be washed off with water, and the brass rubbed with whiting and soft leather. A mixture of muriatic acid and alum, dissolved in water, imparts a golden color to brass articles that are steeped in it for a few seconds.

6.—First boil your articles in a pan with ordinary washing soda, to remove the old lacquer; then let them stand for a short time in dead nitric acid; then run them through bright dipping nitric acid. Swill all acid off in clean water, and brighten the relieved parts with a steel burnisher, replace in clean water, and dry out in beech sawdust. Next, place your work on the stove till heated, so that you can with difficulty bear your hand on the articles, and apply pale lacquer with a brush; the work will burn if heated too much or too rapidly.

7.—Put a coat of nitric acid over the part you want cleaned, with a piece of rag; as soon as it turns a light yellow rub it dry, and the brass will present a very clean appearance; if not satisfactory, repeat.

8.—Oxalic acid and whiting, mixed, and applied wet with a brush, and brushed again when dry with a soft plate brush to polish with dry whiting.

9.—Chalk, 10 parts; white bole, 4 parts; magnesium carbonate, 1 part; iron oxide, 1 part.

10.—Oxalic acid, 1 dr.; rotten stone, in powder, 4 oz.; boiling water, 1 oz.; oil of turpentine, ½ dr.; soft soap, ½ oz.; sweet oil, 5 dr. First dissolve the acid in the water, then add the rotten stone and other ingredients.

11.—Oxalic acid, 1 part; iron peroxide, 15 parts; powdered rotten stone, 20 parts; plam oil, 60 parts; petrolatum, 4 parts. See that solids are thoroughly pulverized and sifted, then add and, thoroughly incorporate, the oil and petrolatum.

12.—Starch, 1 part; powdered rottten stone, 12 parts; sweet oil, 2 parts; oxalic acid, 2 parts; water to mix.

13.—To 1 oz. of powdered potassium bichromate add 2 oz. each of sulphuric acid and water. Apply by dipping or rubbing the article to be cleaned, and wash off immediately with water; rub dry, and polish with rotten stone.

14.—Oxalic acid, 3 parts; water, 50 parts; kieselguhr, 7 parts. Dissolve the acid and add the earth. Shake before using.

15.—It would not suffice to pickle brass objects; the brilliancy thus produced would not be durable. To attain a good polish, the surfaces have to be rubbed with very fine tripoli, mixed with olive oil; next rinse with soap water and wipe dry, with fine linen.

16.—Brass work that is so dirty from smoke and heat as not to be cleaned with oxalic acid should be thoroughly washed or scrubbed with soda, or potash water, or lye. Then dip in a mixture of equal parts of nitric acid, sulphuric acid and water; or, if it cannot be conveniently dipped, make a swab of a small piece of woolen cloth upon the end of a stick, and rub the solution over the dirty or smoky parts; leave the acid on for a minute, and then wash clean and polish.

17.—*Fly Specks, To Remove.*—If you cannot wash off the fly specks with soap and warm water on a cloth, there is no way that an amateur can refinish lampwork with any satisfaction. To do this the lamp must be taken apart and the brasswork boiled in caustic soda to remove all oil and varnish; then rinse in hot water and dip in strong nitric acid for a few seconds only, when it will come out clean and bright; then rinse clean in boiling water. Dry in sawdust, brush off, and lacquer wth thin shellac varnish. The metal must be warm and perfectly free from grease.

18.—*Gun Shells.*—For such as have been used, boil in a strong solution of caustic soda, rinse in hot water, then dip in a hot pickle of sulphuric acid, 1 part; water, 4 parts; and rinse in hot water.

19.—*Inlaid Work.*—Mix tripoli and linseed oil, and dip felt into the preparation. With this, polish. If the wood be rosewood or ebony, polish it with finely powdered elder ashes, or make a polishing paste of rotten stone, a pinch of starch, sweet oil and oxalic acid, mixed with water.

20.—*Lighting Fixtures.*—Have the water clean and boiling in two vessels. Dip in one water and then in the next as soon as taken from the nitric acid bath, so that there shall be no traces of acid on the fittings. Dry in boxwood sawdust while hot, and place upon a piece of hot sheet iron over a stove. As soon as all traces of water have left, quickly lacquer with very thin shellac varnish, using a camel's-hair brush. You can make the lacquer by dissolving shellac in best alcohol. Do not touch the metal with the fingers before lacquering

21.—*Tarnish, To Prevent.*—a.—Dissolve 1 oz. of best brown shellac in 1 pt. of alcohol (wood alcohol will answer, and it is much cheaper than that distilled from grain), and add to such solution 1 dr. of gamboge and 3 dr. of cape aloes. Heat the articles, and apply the lacquer with a camel's-hair brush. The articles should be thoroughly cleaned and polished before the lacquer is applied, otherwise the result wil be disappointing.

b.—Bleached shellac, 2 oz.; camphor, ½ oz.; alcohol, 16 oz. While wood alcohol, or denatured alcohol, will answer very well for lacquers, we wish again to warn those who employ the methyl spirit of its poisonousness, and its power to cause blindness even by its fumes.

Brass and Copper Polishing.

The *Wiener Seifensieder-Zeitung* publishes the following collection of formulas for copper and brass polishers:

1.—Cream of tartar, 5 parts; alum, 10 parts; sodium chloride, 10 parts; water, 100 parts. The salts are dissolved in the water, and the solution is allowed to stand several days. A white precipitate is formed, from which the liquid is decanted. If turbid, the liquid must be filtered through paper.

2.—Dissolve 10 parts of tartaric acid in 100 parts of water, and mix with 5 to 10 parts of ferric oxide.

3.—Pour 1 part of sulphuric acid carefully into 20 parts of water, stirring with a stick of wood. Dissolve 2 parts of alum in the dilute acid, and add 2 parts of fine potato meal. The meal must be thoroughly rubbed down with the acid liquid, added in small portions at a time, until a homogeneous paste is obtained. This preparation must be kept in bottles closed with paraffined corks.

4.—Oxalic acid, 500 parts, tripoli, or infusorial earth, 150 parts.

5.—Ammonia water, concentrated, 50 parts; water, 100 parts; prepared chalk, 20 parts. Red or yellow aniline dye, as much as desired.

6.—Sal ammoniac, 10 parts, is dissolved in 75 parts of water, and 5 parts of chalk added.

7.—Flowers of sulphur, 10 parts; ground chalk, 10 parts; mix with 100 parts of vinegar.

8.—Alcohol, 80%, 100 parts; olein, 50 parts; tartaric acid, 80 parts; tripoli, 30 parts. Mix the tartaric acid (in powder form) with the alcohol, whereby the acid is partly dissolved. Then add the olein, and finally the tripoli, taking care to mix thoroughly.

9.—Rotten stone, 3 oz.; powdered soap, 1 oz. Apply with a little spirit of turpentine or sweet oil.

10.—*Brass, Copper, German Silver, etc., To Polish.*—Use Vienna lime, with oil.

Brass.—1.—Rub the metal with rotten stone and sweet oil, then rub off with a piece of cotton flannel, and polish with soft leather. A solution of oxalic acid, rubbed over tarnished brass, soon removes the tarnish, rendering the metal bright. The acid must be washed off with water, and the brass rubbed with whiting and soft leather. A mixture of muriatic acid and alum dissolved in water imparts a golden color to brass articles that are steeped in it for a few seconds.

2.—In polishing old brasswork which has been scratched and tarnished by wear, pumice or bath brick should be used with soap and water for scouring off with, and rotten stone, with kerosene oil, for the wet finish, and dry for the final polish. The same method should be used for new brass work. New work should require, after leaving the lathe and vise tools, but little polishing or grinding, and every good workman should try to avoid using an emery stick or emery cloth, as with proper care in the use of tools a great deal of grinding and polishing can be dispensed with. The polishing of metals varies somewhat according to their character, but the main principle underlying all is the substitution of progressively finer scratches for those left by the material last used, until they become so delicate as to be invisible without the aid of a microscope.

3.—Three parts of axalic acid are dissolved in 40 parts of hot water; add 100 parts of powdered pumice stone, 2 parts of oil of turpentine, 12 parts of soft soap and 12 parts of a fat oil.

4.—Rotten stone, 7 oz.; powdered oxalic acid, 1 oz. Both are used with a little water.

5.—Soft soap, 2 oz.; rotten stone, 4 oz.; beaten to a paste.

6.—Rotten stone, made into a paste with sweet oil.

7.—Rotten stone, 4 oz.; oxalic acid, in fine powder, 1 oz.; sweet oil, 1½ oz.; turpentine, q. s. to make a paste.

The above are used to clean brasswork, when neither varnished nor lacquered. The first and last are best applied with a little water. Both require friction with soft leather.

8.—Make a paste of equal parts of sulphur and chalk, with sufficient vinegar to reduce it to the proper consistency; apply it to the metal while moist, allow it to dry on, and rub with a chamois skin. For ornaments or engraved work, clean with a brush.

9.—Another process, and one that gives to the brass a very brilliant color, is to make a wash of alum boiled in strong lye, in the proportion of 1 oz. of alum to 1 pt. of lye. Wash the brass with this mixture, and afterward rub with chamois and tripoli.

10.—A weak solution of ammonia in water makes an excellent wash. Apply it with a rag, dry with a piece of chamois, and afterward rub with a piece of chamois and a very small quantity of jewelers' rouge.

11.—Place 2 oz. of sulphuric acid in an earthen vessel and add 1 qt. of cold soft water; after the heat that is generated has passed off add 1 oz. each of tripoli and jewelers' rouge. When well mixed put in a bottle for use.

12.—Brass may be polished without a burnisher by using an exceedingly fine cut file and fine emery cloth.

13.—Small articles to be polished should be shaken by themselves for a short time; then some greasy parings of leather should be put in the barrel with them. After they have been shaken smooth the greasy leather parings are replaced by clean ones, and the shaking is continued as long as necessary.

14.—When the brass is made smooth by turning, or filing with a very fine file, it may be rubbed with a smooth, fine-grained stone, or with charcoal and water. When it is made quite smooth, and free from scratches, it may be polished with rotten stone and oil, alcohol, or spirits of turpentine.

15.—Brasswork can be polished by rubbing the metal with finely powedered tripoil mixed with sweet oil, and applied with a rubber made from a piece of an old hat or felt. Or else a mixture of glycerine, stearine, naphthaline or creosote, mixed with dilute sulphuric acid, can be used.

16.—Magic Polish for Brass.—Sulphuric acid, 20 parts; pulverized bichromate of potash, 10 parts; dilute with an equal weight of water; apply well to the brass. Wash well in water, immediately wipe dry, and polish with rotten stone.

17.—Brass Movements.—Spanish whiting is mixed with clear rain water in the proportion of 2 lb. to the gal. Stir, and let stand for a few minutes to allow the gritty portion to settle; decant off the water into another vessel and again allow it to stand. The settlings in the second vessel are mixed with jeweler's rouge and used for polishing.

18.—Petroleum Brass Polish.—Tripoli, 16 av.oz.; Spanish whiting, 16 av.oz.; powdered rotten stone or pumice,, 8 av.oz.; petroleum, 2 fl.oz.; petrolatum, to make a soft paste; oil of myrbane to suit.

19.—Pickling Brass Castings.—A solution is frequently made up by mixing 3 parts of sulphuric acid and 2 parts of nitric acid, and adding to each quart of the mixture about a handful of common table salt. This mixture is frequently used undiluted with water, and is to be handled with great care, as it will attack the hands badly. One advantage of this solution is that it leaves a good color on the castings, and hence it is frequently used for this purpose. The pickling solution used for brass castings must be kept in an earthenware crock or in a vitrified bathtub, and the bath must be large enough to dip the large castings into it. Owing to the fact that hydrofluoric acid will attack sand, it cannot be kept in a crock or jug, as it would immediately eat a hole through it and escape. Hydrofluoric acid must be kept in a lead carboy, but the dilute acid can be kept in wooden tubs or barrels. Either dilute or concentrated hydrofluoric acid will dissolve glass very readily, and hence cannot be kept in a glass bottle. Concentrated sulphuric acid is frequently kept in iron tanks, but dilute sulphuric acid attacks iron readily, and hence it is necessary to keep dilute sulphuric acid in earthenware jugs and jars, glass bottles or wooden tubs or vats.

Brickwork, To Remove Mildew.

Builders' acid (hydhochloric acid) is often used for removing white stains from brickwork. Its efficacy in the case of mildew would be doubtful. A coat of linseed oil on the perfectly dry brick would have a good preventive tendency. Melted paraffine, applied hot, and worked in with a paint burner, would also be efficacious. Perhaps either of the last named applications would destroy the mildew or white stain also. Acid, used by an experienced man, would not injure the joints.

Bristles, To Bleach.

Cleanse well in a preparation of tepid water and soft soap. Then dip in cold water. Leave for 2 or 3 days in an aqueous solution of sulphurous acid, after which wash and dry.

Britannia Metal.

1.—Use finely powdered whiting, 2 tablespoonfuls of sweet oil and a little yellow soap. Mix with spirits of wine to a cream. Rub on with a sponge, wipe off with a soft cloth, and polish with a chamois skin.

2.—Rub first with jewelers' rouge, made into a paste with oil; wash in suds, rinse dry, and polish with chamois.

Broadcloth, To Remove Stains.

Grind fine 1½ oz. of pipeclay; mix with 18 drops of alcohol and the same quantity of spirits of turpentine. Moisten a little of this mixture with alcohol and rub on the stains. When dry, rub off with a woolen cloth.

Bronze and Gilt. See also **Brass and Copper above.)**

1.—Clean the surface, first of all, with whiting and water, or crocus powder, until it is polished; then cover with a paste of plumbago and crocus, mixed in the proportions that will produce the desired color. Heat the paste over a small charcoal fire. Perhaps the bronzing has been produced by a corrosive process; if so, try painting a solution of sulphide of potassium over the cleaned metal.

2.—Articles of bronze are best cleaned by the use of a paste made of powdered chicory and water. The paste is spread over the bronze and rubbed well over the surface by means of a stiff brush (an old stiff tooth brush will answer), and then allowed to dry on the article. After drying, rinse off the powder with running water, and dry in the sun. Wiping off with an oiled rag will improve the looks of modern bronzes.

3.—Rub delicate objects with a sponge charged with a mixture of 28 parts of alcohol, 14 parts of water and 4 parts of lavender oil.

4.—*Fly Specks.*—Lavender oil, 1 dr.; alcohol, 1 oz.; water, 1½ oz. Use a soft sponge, and proceed quickly, with little rubbing.

5.—*Gilded Bronze.*—a.—Commence by removing the spots of grease and wax with a little potash or soda dissolved in water. Let dry, and apply the following mixture with a rag: Carbonate of soda, 7 parts; whiting, 15 parts; 85° alcohol, 50 parts; water, 125 parts. When this coating is dry pass over it a fine linen cloth or a piece of supple skin. The hollow parts are cleaned with a brush.

b.—After removing the grease spots, as specified above, let dry, and pass over all the damaged parts a pencil dipped in the following mixture: Alum, 2 parts; nitric acid, 65 parts; water, 250 parts. When the gilding becomes bright, wipe, and dry in the sun or near a fire.

c.—Wash in hot water containing a little soda, dry, and pass over the gilding a pencil soaked in a liquid made of 30 parts of nitric acid, 4 parts of aluminum sulphate and 125 parts of pure water. Dry in sawdust.

d.—Immerse the objects in boiling soap water and facilitate the action of the soap by rubbing with a soft brush; put the objects in hot water, brush them carefully, and let them dry in the air; when they are quite dry rub with an old linen cloth of a soft skin the shining parts only without touching the others.

e.—If greasy, wash carefully in suds; or, better, dip into a hot solution of caustic potash, and then wash in suds with a soft rag, and rinse in running water. If not then clean and bright, dip into the following mixture: Nitric acid, 10 parts; aluminum sulphate, 1 part; water, 40 parts. Mix. Rinse in running water.

f.—Boil in a weak alkali prepared from an infusion of wood ashes. Then clean with a solution composed of equal parts of nitric acid, water and alum.

6.—*Imitation of Gilding.*—There are varnished bronzes so nearly resembling gilded bronzes in appearance that they may be easily confounded. To distinguish them it is sufficient to touch them with a glass rod dipped in a solution of mercury bichloride (corrosive sublimate). If the object is gilded the point touched will not change color; if not, a brown spot will be formed.

7.—*Ornaments.*—Boil the articles in ordinary soaper's lye; rinse out, and roll in bran and sawdust. If the bronze is of the stamped variety, the lye must be mixed with salt. The ornaments should then be properly brushed, but no water must get to the back. A well-known method of cleaning gold-colored bronze articles consists in washing them in the above lye and brushing thoroughly with a brush, then passing them through a fluid made up of equal parts by weight of water, nitric acid and alum, drying them with a rag and gently warming them.

8.—*Oxidized Bronzes.*—First dip in strong soda lye, then in a bath containing 1 part of sulphuric acid to 12 parts of water. Rinse in clean water, and next in water containing a little ammonia. Dry, and rub with a polishing powder or paste.

9.—*Statuary.*—Use weak soap suds or aqua ammonia.

Brushes.

Dissolve a piece of soda in some hot water, allowing a piece the size of a walnut to 1 qt. of water. Put the water into a basin, and after combing out the hair from the brushes, dip them, bristles downward, into the water and out again, keeping the backs and handles as free from the water as possible. Repeat this until the bristles look clean; then rinse the brushes in a little cold water; shake them well, and wipe the handles and backs with a towel, but not the bristles, and set the brushes to dry in the sun, or near the fire; but take care not to put them too close to it. Wiping the bristles of a brush makes them soft, as does also the use of soap.

Brushes, Varnish, To Keep.—Varnish brushes should never be allowed to touch water, as it not only injuries the elasticity of the hair, but a rosin is deposited in the hilt of the brush which can never be thoroughly removed, and which will work out little by little when the brush is used, destroying the glossy surface which otherwise might be obtained.

Calico and Linen.

1.—When linen or calico is discolored by washing, age, or lying out of use, the best method of restoring the whiteness is by bleaching in the open air and exposure on the grass to the dews and winds. There may occur cases, however, where this may be difficult to accomplish, and where a quicker process may be desirable, and the following is the best:

2.—Lay the linen for 12 hours in a lye formed of 1 lb. of soda to 1 gal. of boiling-hot soft water; then boil it for half an hour in the same liquid. Then make a mixture of chloride of lime with 8 times its quantity of water, which must be well shaken in a stone jar for 3 days, then allowed to settle, and being drawn off clear, the linen must be steeped in it 36 hours and then washed out in the ordinary way. This will remove all discoloration.

Candle Grease, Removing.

1.—For all kinds use 95% alcohol.

2.—Scrape off as much as possible with a knife, then lay a thin, soft white blotting paper upon the spots and press with a warm iron. By repeating this, the spermaceti will be drawn out. Afterward, rub the cloth where the spots have been with some very soft brownish paper.

Cane-seated Chairs.

1.—Clean the articles with a solution of oxalic acid. Their color will be restored.

2.—Wash with hot water and a sponge, using soap, if necessary. Dry in a current of air.

Canvas, To Render Mildew-proof.

1.—Saturate the cloth in a hot solution of soap (¼ lb. to 1 gal. of water), wring out, and digest it for 12 hours in a solution of ½ lb. of alum to 1 gal. of water.

2.—Treatment with a strong aqueous solution of alum or lead acetate answers very well. Use the following: Alum, 2 lb., dissolved in 60 lb. of water; blue vitriol, 2 lb., dissolved in 8 lb. of water: to which is added gelatine, 1 lb., dissolved in 30 lb. of water; lead acetate, ½ lb., dissolved in 30 lb. of water. The solutions are all hot, and separately mixed, with the exception of the vitriol, which is added. (See also receipts for waterproofing cloth.)

3.—Dissolve 1 lb. of zinc sulphate in 40 gal. of water, and then add 1 lb. of sal soda. When dissolved, 2 oz. of tartaric acid are added. This holds the partially separated zinc carbonate without neutralizing the excess of alkali used. The canvas, etc., should be soaked in this solution for 24 hours, and then dried without wringing.

4.—*To Remove Mildew.*—Wash with a solution of calcium hypochloride (bleaching powder) in cold water or vinegar. Use plenty of cold water afterward.

5.—*Renovation.*—Coat it with a black leather varnish, such as the following: Digest shellac, 12 parts; white turpentine, 5 parts; gum sandarac, 2 parts: lampblack, 1 part; with spirits of turpentine, 4 parts; and alcohol, 96 parts.

Carpets.

1.—If brooms are wet with boiling suds once a week they will become very tough, will not cut a carpet, and will last much longer. A handful or so of salt sprinkled on a carpet will carry the dust along with it and make the carpet look bright and clean. A very dusty carpet may be cleaned by dipping the broom in cold water, shaking off all the drops, and sweeping a yard or so at a time. Wash the broom, and repeat, until the entire carpet has been swept.

2.—Use 1 pt. of oxgall to 1 pailful of water; after washing, apply cold water to rinse out the oxgall, and finally sponge as dry as possible.

3.—A specimen of an American carpet soap (says the *American Soap Journal*), exported to Europe, found its way to the municipal laboratory of the city of Breslau, and after examination received the following verdict: "This soap is to be used by making a stiff lather from a rather concentrated solution of the soap; this is then applied to the carpet and left to dry. After the drying the soap has become brittle, and can be beaten out, the single particles so removed taking the dirt along. The analytical data were as follows: Water, 9.67%: residue on drying, 90.33%; ash, 22.2% (in the same, 19.3% sodium carbonate determined by trituration). The separated fatty acids showed: Melting point, 43-44° C.; congealing point, 40-41° C.; acid number, 214.15; iodine number, 38.0. Accordingly, this carpet soap is nothing more nor less than an honest tallow-soda soap. Its effect depends on the circumstance that with such soap a stiff lather is only obtained with concentrated solutions, which then remains and dries; soaps made with palm oil and other exotic fats, on the other hand, yield a strong lather with thin solutions, but this lather subsides again rapidly."

4.—The following formula, known as "Clark's Wash for Carpets," may be found serviceable: Solution a.—Dissolve 10 parts of soap in 20 parts of water, add 3½ parts of soda and ½ part each of ammonia water and alcohol. Solution b, which is the actual cleansing liquid, consists of 4 parts of ammonia water and 3 parts of alcohol, diluted with water. This solution is first used, and when the dirt loosened by it has been removed the soap solution is applied. Carpets thus treated are said to regain much of their original colors, the entire operation of washing and drying requiring but a few hours, and the carpet need not be taken up.

5.—*Dry Cleaning.*—Have ready a number of dry, coarse cotton or linen cloths, some coarse flannels, and 1 or more large pieces of coarse sponge; 2 or more hard scrubbing or scouring brushes, some large tubs or pans and pails, and also a plentiful supply of both hot and cold water. First take out all grease spots; this may be effected in several ways. Well rub the spot with a piece of hard soap, and wash out with a brush and cold water, and well dry each spot before leaving it.

6.—Or, use, instead of the soap, a mixture of fuller's earth, gall and water, well rinsing and drying each spot as before. When this has been done the carpet may be cleaned by the first method mentioned.

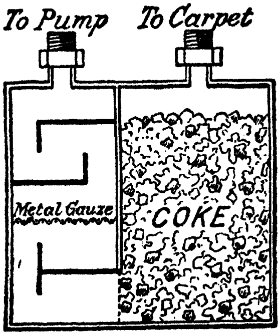
7.—*Grape Stains, To Remove.*—Wash out with warm soapsuds and a little ammonia water.

8.—*Ink, To Remove.*—First, take up as much as possible of the ink with a teaspoon, if in considerable quantity; with a blotting pad, if not so plentiful, using the latter under either condition at the finish. Now pour cold sweet milk over the spot, and after letting it remain a moment, take up as before, repeating the process until the milk comes away only slightly stained with black. Finish by using cold water into which some lemon juice has been strained. Finally, rinse with pure water, and dry off with a soft cloth, rubbing the surface slightly as the water is absorbed. Old ink spots may be removed by moistening a crystal of citric acid and rubbing the spot gently, repeating the operation until the spot vanishes.

9.—*Kerosene Oil.*—Spread over the stain, above and below, warm pipeclay, and allow it to remain 24 hours; then brush it off and beat out the carpet.

10.—*Sweeping.*—It is not an easy matter to sweep well, at any rate, if we may judge by experience; for when a broom is put into the hands of the uninitiated more harm than good generally results from the use of it. Without the greatest care and some little knowdelge, furniture and paint, by being knocked about with the broom, may soon receive an irreparable amount of damage. Before sweeping rooms the floors should be strewed with a good amount of dry tea leaves, which should be saved for the purpose; these will attract the dust and save much harm to other furniture, which, as far as possible, should be covered up during the process. Tea leaves also may be used with advantage upon druggets and short-piled carpets Light sweeping and soft brooms are here desirable. Many a carpet is prematurely worn out by injudicious sweeping. Stiff carpet brooms and the stout arms of inexperienced servants are their destruction. In sweeping thick-piled carpets, such as Axminster and Turkey carpets, the servant should be instructed to brush always the way of the pile; by so doing they may be kept clean for years; but if the broom is used in a different way all the dust will enter the carpet and soon spoil it. Salt sprinkled upon the carpet before sweeping will make it look bright and clean. This is also a good preventive against moths.

11.—*Vacuum Cleaning.*—The vacuum system, which may be said to suck the loose dirt from the carpets (for it cannot remove fixed dirt marks or stains, though by removing loose dirt from fixed marks it may make them less pronounced), is now being largely used owing to the many advantages it offers. In the first place, it raises no dust, does not scatter a proportion of the dirt disturbed, as any brushing process must; it is more positive, removing more dirt from beneath a carpet than a brush can get at. It may not be as effective as taking up carpets and underfelts, beating them, and washing the floor, but for ordinary periodical thorough cleaning, as required in hotels and similar places, the vacuum method is considered to make the raising of fixed carpets unnecessary. With a public dining (general meal) room, the raising of the carpet and its cleaning would mean stopping business for a day or two at least; while the cleaning of sitting and bedroom carpets, by raising them, would keep a certain percentage of rooms perpetually unfit for occupation. Vacuum cleaning is quite as quick as surface brushing, and in certain pressing cases it is undertaken without even removing the hangings in the room. The vacuum is produced by an air pump, this being driven by a petrol, or similar motor (when the outfit is portable, and carried in a van from house to house). A good vacuum of 25 in. is easily got, and the general working of the system presents no difficulties. The chief detail, that is kept secret as far as possible, is the "dirt arrester." A pump that may be effective and free working with air will quickly fail if the air is loaded with dust and debris, and the duty of the dirt arrester is to filter this out of the air which is drawn through the substance of the carpet, and which, of course, disengages and carries the dirt from the carpet with it.



The details of an arrester are given herewith, this showing the interior construction in section. Its exterior is simply a box or case, or any convenient shape, the interior being divided up and including a coke air filter bed, as shown. The case must have a door to admit of the dirt being removed (and the coke, which will require washing or renewing), and, needless to add, the door, and the whole case, must be absolutely airtight. The cleaning out of the box must be done as often as the operator judges best, this being governed by the size of the box and the state of the carpet.

Carriages, To Preserve.

1.—Ammonia cracks varnish and fades the colors, both of painting and lining. A carriage should never, under any circumstances, be put away dirty. In washing a carriage, keep out of the sun, and have the lever end of the "setts" covered with leather. Use plenty of water, which apply (where practicable) with a hose or syringe, taking care that the water is not driven into the body to the injury of the lining. When forced water is not attainable, use for the body a large soft sponge. This, when saturated, squeeze over the panels, and by the flow down of the water the dirt will soften and harmlessly run off; then finish with a soft chamois leather and oil-silk handkerchief. The same remarks apply to the underworks and wheels, except that when the mud is well soaked, a soft mop, free from any hard substance in the head, may be used. Never use a "spoke brush," which, in conjunction with the grit from the road, acts like sandpaper on the varnish, scratching it, and, of course, effectually removing all gloss. Never allow water to dry itself on the carriage, as it invariably leaves stains.

2.—Be careful to grease the bearings of the fore carriage so as to allow it to turn freely. Examine a carriage occasionally, and whenever a bolt or slip appears to be getting loose, tighten it up with a wrench, and always have little repairs done at once. Top carriages should never stand with the head down, and aprons of every kind should be frequently unfolded, or they will soon spoil.

Casks and Barrels.

1.—Put a few pounds of unslaked lime in the barrel, add water, and cover. In a short time add more water, and roll the barrel. Rinse with clean water.

2.—*Cider Casks.*—a.—Half fill each cask with boiling water, and add ¼ lb. of pearlash; then bung it up, and turn over occasionally for 2 days; then empty, and wash with boiling water.

b.—Scald out with boiling water; if the heads are out, put them over a straw fire for a few minutes, so as to slightly char the inside. If you have a steam boiler, partially fill with water, and admit steam through the bunghole by a pipe down into the water, and so boil.

3.—*Musty Casks.*—a.—Have the casks well scrubbed with boiling liquor in which a little soda ash has been dssolved. If they are not wanted for immediate use, let them stand exposed to the air, one head out, for a month; there is no greater purifier than the atmosphere. Then head up, slightly steam, blow off, and send to cellar to be filled. If wanted for use, scrub, then gently fire until well hot through, steam, etc., as before. They should all be tested for sweetness, by chip-ing and smelling, before being headed up. If not wanted for use, when finished put about 1 pt. of bisulphite of lime and water, 1 to 4 of water, and they will keep good in a cellar for 12 months.

b.—Burn a little sulphur in the empty casks, bung, and let them stand for a day.

4.—*Vinegar Casks.*—Old vinegar barrels become impregnated to such an extent with acetous substances that it is next to impossible to render them fit for the storage of any other liquid. Fill the barrels with milk of lime and let this remain in them for several months, then rinse out well with plenty of warm water, and steam them inside for half an hour.

5.—*Wood Taste, To Remove.*—Fill the barrels with lime water, adding for each 14 gal. capacity about 178 gr. of potash, and allow them to stand 6 to 8 days, after which they should be washed out with clean water. The fluid can be used over again, especially if to each new cask some more lime and potash be added.

Celluloid Collars and Cuffs, to Whiten.

1.—If the coloring does not disappear when the affected portions are rubbed with a woolen cloth and a little tripoli, and then polished with a clean woolen rag, the injury is a permanent one.

2.—Saleratus is the best cleansing agent.

Celluloid Covered Mountings.

Rub the covered parts with a woolen cloth and a little tripoli, and polish with a clean woolen rag.

Chamois Skin.

1.—Soak in a weak solution of washing soda, then in soapsuds for 2 hours; then rinse thoroughly in water, and finally in a solution of soap and soda, and dry.

2.—Wet the chamois leather in water just off cold—not at all hot—squeeze it between the two hands, then lay it flat on a board or table, and rub soap over both sides; do not treat it as if it were a coarse cloth, but keep squeezing and opening and opening and equeezing it in the hands to get the soap well through it. Next rinse it in several waters till the dirt is out—cold water always. Examine if more soap is wanted; if so, again lay the piece flat and rub the soap over every inch of it. Then press and squeeze and rinse as before until it becomes clean. Hang it up to half dry, then rub it in the hands to soften and stretch it, and continue this until it dries; finally, roll it in a mangle.

3.—To a basinful of soft water add 2 or 3 teaspoonfuls of liquor sodae or potasse, and some rasped soap, and let dissolve. Into this throw the chamois, and let it soak for 2 or 3 hours, then rub clean. Throw it into a basin of tepid water, let lie for a few minutes, then wring out and spread on a clean bath towel. Cover it with another, wrap, and dry quickly. When dry, rub the surfaces together, or, better, brush with a stiff brush (an old nail brush will answer), to restore softness to the skin. A correspondent of the *National Druggist*, some years ago, recommended the addition of a small amount of glycerine to the last rinsing water, which he says prevents the skin from becoming hard and stiff in drying.

China.

Use a little fuller's earth and soda or pearlash with your water.

Clocks and Watches.

In cleaning clock and watch movements, take 1 qt. of water, about 1 teaspoonful or 5 gr. of liquid ammonia or alkali; into this liquid should be grated or scraped fine 5 gr. of common soap. These proportions can be varied as desired, if the following remarks are kept in view: The articles to be cleaned should be plunged into this bath, where they should be allowed to remain at least 10 minutes; 20 or 30 minutes is better, especially for clocks. The articles should be wiped dry when removed from the bath, or polished up with a brush dipped in some polishing powder. Rectified benzine is preferable, as ammonia is apt to turn the movement black, if in excess. Use great care in using benzine, as it is very inflammable, and never should be used at night.

Clothes, To Brush.

Brushing clothes is a very simple but very necessary operation. Fine clothes require to be brushed lightly, and with rather a soft brush, except where mud is to be removed, when a hard one is necessary, being previously beaten lightly to dislodge the dirt. Lay the garment on a table, and brush it in the direction of the nap. Having brushed it properly, turn the sleeves back to the collar, so that the folds may come at the elbow joints; next turn the lapels or sides back over the folded sleeves, then lay the skirts over level with the collar, so that the crease may fall about the center, and double one half over the other, so that the fold comes in the center of the back.

Coffee, Tea and Milk Stains.

1.—These stains are very difficult to remove, especially from light-colored and finely finished goods. From woolen and mixed fabrics they are taken out by moistening them with a mixture of 1 part of glycerine, 9 parts of water and ½ part of aqua ammonia. This mixture is applied to the goods by means of a brush, and allowed to remain for 12 hours, occasionally renewing the moistening. After this time the stained pieces are pressed between cloth, and then rubbed with a clean rag. Drying, and, if possible, a little steaming, is generally sufficient to thoroughly remove the stains.

2.—Stains on silk garments which are dyed with delicate colors, or finely finished, are more difficult to remove. In this case 5 parts of glycerine are mixed with 5 parts of water, and ¼ part of ammonia added. Before using this mixture it should be tried on some part of the garment where it cannot be noticed, in order to see if the mixture will change the color. If such is the case, no ammonia should be added. If, on the contrary, no change takes place, or, if, after drying, the original color is restored, the above mixture is applied with a soft brush, allowing it to remain on the stains for 6 or 8 hours, and is then rubbed with a clean cloth. The remaining dry substance is then carefully taken off by means of a knife. The injured places are now brushed over with clean water, pressed between cloths, and dried. If the stain is not then removed, a rubbing with dry bread will easily take it off. To restore the finish a thin solution of gum arabic, or, in many cases, beer is preferred, is brushed on, then dried, and carefully ironed. By careful manipulation these stains will be successfully removed.

3.—When any article has had tea or coffee spilled over it, be careful not to allow soap to touch it till the stains are removed, for the alkali in the soap will make the coloring matter turn into fast dyes. Spread the stained part over a basin and pour clean, soft, boiling water through it. If the stains prove obstinate, rub in a little powdered borax, and pour on more boiling water; then place the article to soak.

Coins and Medals.

1.—Fr. Rathgen (in the *Chemische Zeitung*) says that coins, medals, etc., as well as small iron articles, may be cleaned as follows: The coating of silver chloride may be reduced with molten potassium syanide, then boil the article in water. Displace the water with alcohol, and finally dry off in a drying closet. When dry, brush off with a suitable brush (soft, like a jeweler's), and finally cover with "zaponlack" (any good transparent lacquer or varnish will answer). Potassium cyanide is deadly poison, and should be handled with care Instead of potassium cyanide alone, a mixture of that and potassium carbonate may be used. Delicate objects of silver become, after treatment in this way, less brittle. Another way is to put the article in molten sodium carbonate and remove the silver carbonate thus formed by acetic acid of 50% strength. This process produces the finest possible polish. The potassium cyanide process may be used with all small iron objects. For larger ones molten potassium rhodanide is recommended. This converts the iron oxides into iron sulphides that are easily washed off, and leaves the surface of a fine black color.

2.—To clean old medals, immerse in lemon juice until the oxidation is entirely removed. A full day is generally sufficient. A longer stay, however, is not disadvantageous.

3.—Immerse in strong nitric acid, and wash immediately in water. If very dirty, or corroded with verdigris, it is better to give them a rubbing with the following: Pure bichromate of potash, ½ oz.; sulphuric acid, 1 oz.; nitric acid, 1 oz. Rub over, wash with water, wipe dry, and polish with rotten stone or chalk.

4.—Make a bath of 10 parts of sulphuric acid and 90 parts of water, and let the coin lie in this until the crust of silver sulphide is dissolved. From 5 to 10 minutes usually suffice. Rinse in running water, then rub with a soft brush and Castile soap, rinse again, dry with a soft cloth, and then carefully rub with chamois.

5.—Dip in a strong, hot solution of potash or soda, rinse, and dip for a moment in nitric acid, after which rinse quickly in running water.

Color, To Restore.

1.—When color on a fabric has been accidentally or otherwise destroyed by acid, ammonia is applied to neutralize the same, after which an application of chloroform will, in almost all cases, restore the original color. The application of ammonia is common, but that of chloroform is but little known.

2.—*Faded Black Cloth or Leather.*—Take of the best quality of blue galls, 4 oz.; of logwood, clean sulphate of iron (copperas), clean iron filings and sumac leaves, each 1 oz.; put the gals, logwood and sumac berries into 1 qt. of the best white-wine vinegar, and heat to nearly the boiling point in a sand bath, then add the iron filings and copperas; digest for 24 hours and strain for use. Apply with a sponge.

3.—*Muslins and Piques.* — French method: Make a strong lather with best white soap dissolved in soft water, and use while rather warm, but not hot. Wash the dress in this, but do not soak it previously. As soon as the lather appears soiled squeeze out the dress, throw away the lather, and wash the dress again in a second lot, and so continue until the dress is thoroughly clean. Then well rinse it in cold water, and afterward in cold water slightly blued. Squeeze all the water out of the dress, but do not wring it, and hang in a shady place to dry; or, if the weather be wet, dry it before the fire. When dry they are to be starched. It is in this operation that the failures in getting up muslins and piques more often occur than in the washing. Use a large basin, and have plenty of starch, and dissolve in the starch, according to the quantity of it, 3 or 4 in. of composite or wax candle. Squeeze the starch well out of the dress, and while it is still wet put it between some old sheets or tablecloths, and pass it between the rollers of a wringing machine or under a mangle; by this means all lumps of starch will be removed. Finish by ironing. Piques should be ironed on the wrong side, as lightly as possible.

Combs.

If it can be avoided, never wash combs, as the water often makes the teeth split, and the tortoiseshell or horn of which they are made rough. Small brushes, manufactured purposely for cleaning combs, may be purchased at a trifling cost; with this the comb should be well brushed, and afterward wiped with a cloth or towel.

Copper. (See also **Brass.**)

1.—Take 1 oz. of oxalic acid, 6 oz. of rotten stone, ½ oz. of gum arabic, all in powder, 1 oz. of sweet oil, and sufficient water to make a paste. Apply a small portion, and rub dry with a flannel or leather.

2.—Use soft soap and rotten stone, made into a stiff paste with water, and dissolved by gently simmering in a water bath. Rub on with a woolen rag, and polish with dry whiting and rotten stone. Finish with a leather and dry whiting.

3.—Copper plates are cleaned by laying them near a fire and pouring on them some turpentine, and then rubbing them with a small, soft brush.

4.—The cleaning of some copper objects with powders or other substances is attended with difficulty on account of their worked and ornamented surfaces. Still, at times, success is complete, by means of acids. If the object is greasy, the grease must first be removed by a hot solution of soda, and then the object immersed in clear water. The bath designed for restoring brilliancy is thus composed: Nitric acid, 2 parts; sal ammoniac, 1 part; or else sal ammoniac, 1 part; nitric acid, 1 part; and water, 1 part. The sal ammoniac is to be dissolved in the water so as to obtain a saturated solution. The object should not be left immersed in the bath more than 2 seconds, and should afterward be rinsed, first in cold water, then in hot, soapy water, and dried with warm sawdust.

5.—Make Armenian bole into a paste with oleic acid.

6.—Rotten stone, 1 part; iron subcarbonate, 3 parts; lard oil, a sufficient quantity.

7.—Iron oxide, 10 parts; pumice stone, 32 parts; oleic acid, a sufficient quantity.

8.—Soap, cut fine, 16 parts; precipitated chalk, 2 parts; jewelers' rouge, 1 part; cream of tartar, 1 part; magnesium carbonate, 1 part; water, a sufficient quantity. Dissolve the soap in the smallest quantity of water that will effect solution over a water bath. Add the other ingredients to the solution while still hot, stirring all the time to make sure of complete homogeneity. Copper tubing, or other parts of apparatus that cannot be readily cleaned by mechanical means, should be well coated with tin.

9.—*Copper Halftones.* — To remove stains from copper halftones, some operators use acetic acid and salt, the salt being dissolved in the acid. The halftone can be brushed with this without disturbing the enamel.

10.—*Copperplate Engravings.* — Wash the sheet on both sides by means of a soft sponge, or brush with water to which 40 grams of ammonium carbonate have been added per liter of water, and rinse the paper each time with clear water. Next moisten with water in which a little wine vinegar has been admixed; rinse the sheet again when water containing a little chloride of lime, and dry it in the air, preferably in the sun. The paper becomes perfectly clear without the print being injured.

11.—*Polished Copper.*—a.—Objects of polished copper, bronze, brass, and other alloys of copper, tarnish through water, and it is sometimes necessary to give them again their bright appearance. To obtain good results it is by no means indifferent what method is pursued. Experience has taught that the best way consists in pickling the article in an acid bath, to wash them next in a neutral bath, to dry them, and subsequently to rub them with a polishing powder.

b.—Make a mixture of powdered charcoal, very fine, 4 parts; spirit of wine, 3 parts; essence of turpentine, 2 parts; to this add water in which one-third of its weight of sorrel salt or oxalic acid has been stirred, and rub the objects with this mixture.

Coral, To Clean and Bleach.

1.—The secret in cleaning coral is to turn the mass bottom upward and suspend it by means of a piece of wire in the saucepan, so that the dirt, as it boils off, may drop into the water, instead of down the septa. A strong solution of ordinary washing soda, or, better, oxalic acid, is to be used to boil in it. The mass is to be moiled at least 3 hours. This is not only to clean the coral, but to bleach it also.

2.—Apply a mixture of hydrochloric acid and water, or wash the coral with a stiff brush in cold salt and water, with a little soap powder; a little chloride of lime will improve it; then put in the sun to dry and bleach.

3.—First, well wash in very dilute hydrochloric acid (1 part acid to 30 parts of water); then well rinse in water, then put into some chloride of lime and water.

Corks Cleaning.

1.—Old corks can be cleaned by washing with water containing 10% of hydrochloric acid, then immersing in a solution of sodium hyposulphite and hydrochloric acid. Finally, the corks are washed with a solution of soda and pure water, says the *Pharmaceutical Era.* Corks containing oil or fat cannot be cleaned by this method.

2.—Used corks are placed in a tub with a perforated head. It must be capable of descending into the tub, so as to rest directly on the corks. Pour on boiling water in which, to each 10 parts, there has been added 0.5 part of sulphuric acid. Allow it to stand 15 to 20 minutes, run the water off, and rinse out the tub. Treat the whole in the same manner with clear water. Then the same treatment with a solution of 0.13 part of alum in 8,500 parts of water. After half an hour run the water off. Lay the corks in the sun; in 2 days they are ready. Do not expose them to the night air.

Cotton and Linen, Bleaching.

1.—Make a strong solution of chloride of lime (hypochlorite of lime—bleaching powder) in water, allow to settle, and draw off the clear liquid. Rinse the goods in clean water containing about 5% of sulphuric acid, and then pass them slowly through the bleaching solution. They should then be well rinsed in water containing a little carbonate of soda. If the cloth is much colored it may be necessary to allow it to remain for a short time in the bath. This is the usual method of bleaching in laundries.

2.—Hydrated sodium oxide, 0.227; liquid sodium perchlorite, free from lime, 0.900; nitro-benzol, 0.002; condurango colorant, 0.001; water, 0.370.

Crape.

1.—Crape is cleansed by rinsing it in oxgall and water, to remove the dirt, afterward in pure water to remove the gall, and lastly in a little gum water to stiffen and crisp it. It is then clapped between the hands until dry.

2.—*To Restore.*—a.—Black crape may be freshened and made to look almost equal to new if treated in the following way: Lay over the ironing table a piece of black cambric or cloth of any kind, and pin the piece of crape smoothly through to the blanket, stretching it out to its original size. Wring another piece of black cambric out of water and lay it over the crape, patting it down with the palm of the hand. Now take hot flatirons and pass them over the wet cloth, letting them just touch the cloth, but allowing no pressure to come upon the crape. When the cloth has become dry from the heat of the iron remove it, but let the crape remain pinned down until all the moisture has evaporated and it is perfectly dry. The crape will now feel and look like new. A long weil can be renovated in this way, making sure that the part redressed comes under the edge of the wet cloth.

b.—Skim milk and water, with a little bit of glue in it, made scalding hot, is excellent to restore rusty Italian crape.

If clapped and pulled dry, like muslin, it will look as good as new; or, brush the veil till all the dust is removed, then fold it lengthwise, and roll it smoothly and tightly on a roller. Steam it till it is thoroughly dampened, and dry on the roller.

Crocks and Jars, To Remove Grease.

1.—Use hot water and sal soda.

2.—Porous earthenware often becomes foul with organic matter when used to hold water. Use 1 oz. of muriatic acid, rubbed on the exterior and interior with a piece of flannel. Wash afterward with hot water.

Diamonds.

Clean all diamonds and precious stones by washing them with soap and water, with a soft brush, adding a little ammonia in the water, and then dry in fine boxwood sawdust. A little potash or pearlash put in the water will answer the same purpose.

Earthenware. (See **Crocks and Jars.**)

Engravings.

1.—Presuming these to be mounted, proceed in the following manner: Cut a stale loaf in half with a perfectly clean knife; pare the crust away from the edges. Place the engravings on a flat table, and rubbing the surface with the fresh cut bread, in circular sweeps, lightly but firmly performed, will remove all superficial markings. Soak the prints for a short time in a dilute solution of hydrochloric acid, say 1 part of acid to 100 parts of water, and then remove them into a vessel containing a sufficient quantity of clear chloride of lime water to cover them. Leave them there until bleached to the desired point. Remove, rinse well by allowing to stand an hour in a pan in which a constant stream of water is allowed to flow, and finally dry off by spreading on clean cloths. Perhaps they may require ironing between two sheets of clean paper.

2.—Put the engraving on a smooth board, cover it thinly with common salt finely powdered; squeeze lemon juice upon the salt so as to dissolve a considerable portion of it; elevate one end of the board so that it may form an angle of about 45 or 50° with the horizon. Pour on the engraving boiling water from a tea kettle until the salt and lemon juice be all washed off; the engraving will then be perfectly clean and free from stains. It must be dried on the board, or on some smooth surface, gradually. If dried by the fire or the sun, it will be tinged with a yellow color.

3.—Hydrochloric acid, oxalic acid, or eau de Javelle, may be employed, weakened by water. After the leaves (if it be a book) have by this means been whitened, they must be bathed again in a solution of sulphate of soda, which will remove all the chlorine and leave the leaves white and clean. They will, however, have lost all firmness of texture, owing to the removal of the size from the paper. It will, therefore, be advisable to give a bath of gelatine and alum, made with boiling water, to which may be added a little tobacco, or any other coloring substance, to restore the tint of the now too white paper.

4.—Immerse each mildewed sheet separately in a solution made in the proportions of ½ lb. of chloride of lime to 1 pt. of water. Let it stand, with frequent stirring, for 24 hours, and then strain through muslin, and finally add 1 qt. of water. Mildew and other stains will be found to disappear very quickly, and the sheets must then be passed separately through clear water, or the chloride of lime, if left in the paper, will cause it to rot. Old prints, engravings, and every description of printed matter, may be successfully treated in the same manner.

5.—"I have in my time cleaned many hundreds. The plan which I adopt is as follows: I place them, one or two at a time, in a shallow dish, and pour water over them until they are completely soaked or saturated with it. I then carefully pour off the water and pour on to the prints a solution of chloride of lime (1 part liquor calcis chlorate to 39 parts of water). As a general rule, the stains disappear as if by magic, but occasionally they are obstinate. When that is the case, I pour on the spot pure liquor calcis chlorate, and, if that does not succeed, I add a little dilute nitro-muriatic acid. I have never had a print which has not succumbed to this treatment; in fact, as a rule, they become too white. As soon as they are clean they must be carefully washed with successive portions of water until the whole of the chlorine is got rid of. They should then be placed in a very weak solution of isinglass or glue, and many collectors color this solution with coffee grounds, etc., to give a yellow tint to the print. They should be dried between folds of blotting paper, either in a press or under a heavy book, and finally ironed with an ordinary flat iron to restore the gloss, placing clean paper between the iron and the print. Grease stains are much more difficult. I find benzine best. Small grease spots may be removed by powdered French chalk being placed over them, a piece of clean blotting paper over the chalk, and a hot iron over that."—*F. Andrews.*

6.—Mildew often arises from the paste used to attach the print. Take a solution of alum of medium strength and brush on back and face of the engraving 2 or 3 coats, then make the frame airtight by pasting a strip of paper all around the inside of the glass, leaving about ½ in. overlapping (taking care not to paste the paper on the glass so as to be seen from the front), then place your glass in frame, take the overlapping piece and paste to side of rabbet; place your picture in position, spring backboard in, and then place a sheet of strong paper (brown) on the table, damp it, and paste around back of frame; lay it on to the paper, leave to dry, cut level. If this does not answer, there will be no help for it, but dust off as the mold accumulates. Do not brush on surface with the alum if the engraving is colored, but sveeral coats on the back.

7.—It has been found that ozone bleaches paper perfectly without injuring the fiber in the least. It can be used for removing mildew and other stains from engravings that have been injured by hanging on the walls of damp rooms. The engravings should be carefully coistened, and suspended in a large vessel partially filled with ozone. The ozone may be generated by putting pieces of clean phosphorus in the bottom of the vessel, partially covered with water; or by passing electric sparks through the air in the vessel.

8.—If the engravings are very dirty, take 2 parts of common salt and 1 part of common soda, and pound them together until very fine. Lay the engraving on a board, and fasten it with drawing pins, and then spread the mixture, dry, equally over the surface to be cleaned. Moisten the whole with warm water and a little lemon juice, and, after it has remained about a minute, or even less, tilt the board up on its end and pour over it a kettleful of boiling water, being careful to remove all the mixture, and avoid rubbing. If the engraving is not very dirty, the less soda used the better, as it has a tendency to give the engraving a yellow hue.

Emery.

Boil with caustic potash, stirring constantly, then wash with acid dilute, and dry.

Emery Wheels.

To remove grease, wash with bisulphide of carbon.

Feathers and Birds.

1.—To clean feathers from their own animal oil, steep them in 1 gal. of water mixed with 1 lb. of lime, stir them well, and then pour off the water and rinse the feathers in cold spring water. To clean feathers from dirt, simply wash them in hot water with soap. Rinse them in hot water.

2.—Colonel Wragge treated the soiled plumage of albatrosses, Cape petrel, etc., by simply washing the feathers in rain water, after the process of skinning, and then laying a thick mixture of starch and water over the portion to be cleansed. Next he laid the birds aside, and left them till the plastering of starch had become thoroughly dry. He then removed the dry plaster by tapping it, and found that the feathers had become much cleaner. Old specimens may be cleaned in this way. Feathers may be set by just arranging them naturally with a needle or any pointed instrument.

3.—*Bird Skins.*—Make a strong solution of salt in water, saturate a large and thick cloth with it. Wrap the bird up in the damp cloth in as many folds as you can, not disarranging the plumage. Look at the bird in 6 hours, and if not long dried on, the blood will be soft; if not soft, keep it in the cloth longer, and rewet it. When soft, rub out with gentle pressure, putting something hard under each feather with blood on, and rubbing with the back of a knife. Of course, each feather must be done separately.

4.—*Bleaching.*—a.—The feathers are put into a bath of permanganate of potash, containing 4 to 5 parts of permanganate to 1,000 parts of water; a solution of sulphate of magnesia of the same strength is added, and it is heated to 140° F. (60° C.) at the most. The feathers, previously washed, are put into this bath, then taken out, rinsed, and passed through weak sulphuric acid at about 1¼ to 3° Tw.

b.—It is also possible to bleach the feathers in a bath of 1 part of barium peroxide in 100 parts of water at 86° F. (30° C.). Leave for 48 hours in this solution, wash, pass through a weak acid bath, and wash.

c.—Feathers may be bleached by exposure to the vapor of burning sulphur (sulphurous acid) in a moist atmosphere, but it is usually necessary to remove the oily matters from them before they can be satisfactorily so bleached. This may be accomplished by immersing them for a short time in good naphtha or benzine, rinsing in a second vessel of the same, and thoroughly drying by exposure to the air. This treatment does not injure the feathers.

5.—*Colored.*—These are to be cleaned and rinsed in warm and cold water, but not rinsed in blue water. Colored feathers may also be cleaned in a mixture of 1 part of fresh gall and 3 parts of lukewarm water, washing them in this mixture in the same manner as in the soap liquor. But they will require more rinsing when done by this method, in order to take off all smell of the gall. Dry, and curl as before.

6.—*Grebe.*—Carefully take out the lining, and wash with warm water and soap, as directed for white ostrich feathers, but do not shake them until they are quite dry. Before remaking, carefully repair any rents there may be in the skin.

7.—*Ostrich Ferthers, White.*—a.—White curd soap, cut small, 4 oz., dissolved in 4 pt. of water, rather hot, in a basin. Make the solution into a lather by beating it with birch rods, or wires. Introduce the feathers, and rub well with the hands for 5 or 6 minutes. After the soaping, wash in clean water, as hot as the hand can bear. Shake until dry.

b.—Slightly soften the soiled feathers with warm water, using a camel's-hair brush. Next raise each feather with a flat piece of wood, or a paper knife, and clean them with spirits of wine. Dry with plaster of paris, and afterward brush them carefully with a dry camel's-hair brush.

8.—*White.*—Dissolve 4 oz. of white soap in 2 qt. of boiling water, put it into a large basin or small pan, and beat to a strong lather with a wire egg beater or a small bundle of birch twigs; use while warm. Hold the feather by the quill with the left hand, dip it into the soap liquor, and squeeze it through the right hand, using a moderate degree of pressure. Continue this operation until the feather is perfectly clean and white, using a second lot of soap liquor if necessary. Rinse in clean hot water to take out the soap, and afterward in cold water in which a small quantity of blue has been dissolved. Shake well, and dry before a moderate fire, shaking it occasionally, that it may look full and soft when dried. Before it is quite dry curl each fiber separately with a blunt knife or ivory paper folder.

9.—*Bed Feathers, To Clean and Disinfect.*—a.—Separate them, and remove dust in a willow, then place them in a wide, open copper cone, underneath which is a kettle of boiling water. The steam passes through the perforated lid into the feathers, and heats them to 212°. The feathers are then transferred to hot sheet-metal plates and dried, then again spread on a grate under which is placed a vessel containing chloride of lime, from which, by means of admixed acid, chlorine gas is generated, which permeates the feathers.

b.—Prepare a quantity of lime water in the following manner: Well mix 1 lb. of quicklime in each gal. of water required, and let it stand until all the undissolved lime is precipitated as a fine powder to the bottom of the tub or pan, then pour off the clear liquor for use. The number of gallons to be prepared will, of course, depend on the quantity of feathers to be cleaned. Put the feathers into a clean tub, pour the lime water on them, and well stir them in it until they all sink to the bottom. There should then be sufficient of the lime water to cover them to a depth of 3 in. Let them stand in this for 3 or 4 days, then take them out drain them in a sieve, and afterward well wash and rinse them in clean water. Dry on nets having a mesh about the same size as a cabbage net; shake the net occasionally, and the dry feathers will fall through. When they are dried beat them well to get rid of the dust. It will take about 3 weeks to clean and dry a sufficient quantity for a bed. This process was awarded the prize offered by the Society of Arts.

Felt Hats.

1.—Clean with ammonia and water; if greasy, wash with fuller's earth. Size with glue size, and block while warm. Glue size made by diluting hot glue with hot water. Apply inside, not outside the hat. The thicker the glue the stiffer the hat.

2.—The stains of grease and paint may be removed from hats by means of turpentine or benzine, and if the turpentine leaves a mark finish with a little alcohol.

Firearms.

1.—A good and simple way of cleaning and recoloring the barrels and other metal parts of a double-barrel, shotgun which are quite rusty. Take the barrels from the stock and put them in clean cold water free from gritty matters. Attach the brush to the washing rod and get out all adhering powder and residues; next take tow, and wash until the barrels are quite clean. If the parts have rusted, it will be necessary to use a little emery flour. Dry the barrels with clean cotton rags, rubbing until the metal feels warm. Plug the ports and muzzles securely, then cleanse the outside parts with a strong alcoholic solution of caustic potash, aided, if necessary, with a little emery flour and a soft rag. Rinse thoroughly in water, dry thoroughly, warm, and while warm rub over every part with the following preparation: Pure (dry) zinc chloride, 1 oz.; nitrate of antimony, ¼ oz.; olive oil, 2 oz.; well rubbed down into a smooth, uniform paste. After half an hour's exposure, rub off excess of this paste, and polish with clean, soft rags. In warming the metal avoid overheating it so as to injure the temper.

2.—In the volunteer service there are several fluids used, which are composed of either turpentine, naphtha, petroleum, benzine or gasoline, about one-third, or according to fancy, with machine oil. But the instructions to the troops are—a damp rag, flannel or tow, is all that is required to clean the barrel out; if much water is used, it is liable to run into the action. The butt should be raised when washing out. After washing out and drying, an oily rag or flannel to be used. On many occasions the oily material will be found to be efficacious, without the previous use of water.

3.—Easy method of cleaning guns and rifles when loaded. If a muzzle-loader stop up the nipple or communication hole with a little wax; or, if a breech-loader, insert a cork in the breech rather tightly; next pour some quicksilver into the barrel, and put another cork in the muzzle; then proceed to roll it up and down the barrel, shaking it about for a few minutes. The mercury and the lead will form an amalgam, and leave the barrel as clean and free from lead as the first day it came out of the shop. The same quicksilver can be used repeatedly by straining it through wash leather; for the lead will be left behind in the leather, and the quicksilver will be again fit for use.

4.—If the barrels have become leaded, wet the tow on the rod with spirits of turpentine, as the latter enjoys the property of removing any leading almost equally with quicksilver. Paraffine will also be found useful where neither of the foregoing can be obtained. Never touch the grooves of a rifle with emery, as it will dull their edges, and, consequently, affect the shooting power.

5.—*Rusty.*—a.—Vaseline oil, 4 parts; French turpentine, 1 part; naphtha, 1 part. It is sufficient to thoroughly saturate the oakum wrapped around the wad hook with this mixture and to wipe the interior of the barrels a few times. Next, rub the barrel stock and system externally with a moistened brush, and wipe the rifle clean with a rag.

b.—A lubricating oil which it is said will clean rust from rifle barrels, and also prevent corrosion by nitro powders, has the following formula: Kerosene (free from acid), 2 oz.; sperm oil, 1 oz.; oil of turpentine, 1 oz.; acetone, 1 oz. Mix in the order given. Oil of citronella or oil of bergamot may be added to disguise the odor.

Fishing Nets, Preservation.

The *Allgemeine Fischereizeitung* gives the following receipts for the preservation of fishing nets, which are, of course, also applicable to ropes, etc., in contact with water. Some have been subjected to a long test by the Drontheimer Fischere' Gesellschaft:

1.—For 40 kgm. of cord, hemp or cotton, 3 kgm. of cutch, 1 kgm. of blue vitriol, ½ kgm. of potassium chromate, and 2½ kgm. of wood tar are required. The cutch is boiled with 150 l. of water until dissolved, and then the blue vitriol is added. Next, the net is entered, and the tar added. The whole should be stirred well, and the cordage must boil 5 to 8 minutes. Now take out the netting, lay it in another vessel, cover up well, and leave alone for 12 hours. After that it is dried well, spread out in a clean place, and coated with linseed oil. Not before 6 hours have elapsed should it be folded together and put into the water. The treatment with linseed oil may be omitted.

2.—Dissolve 1 kgm. of blue vitriol in water. Immerse the net, which must be perfectly dry, in the solution for 24 to 28 hours. This treatment must be repeated every 3 or 4 weeks.

3.—The following treatment is said to preserve nets for a long time in a good condition: Soften 1 lb. of good glue in cold water, then dissolve it in 10 gal. of hot soft water, with ½ lb. of curd soap. Wash the nets in soft water, then boil them in this for 2 hours, press out excess of the liquid and hang up overnight. The second bath consists of alum 2 lb.; water, 5 gal.; heat nearly to boiling, and immerse the nets in this for about 3 hours, then press, and transfer to a strong decoction of oak bark or a solution of sumac in warm water (water, 5 gal.; sumac, 8 lb.), and let them remain immersed in this for 48 hours, or longer, if convenient.

Flannel.

1.—*Bleaching.*—Flannel which has become yellow with use may be bleached by putting it for some days in a solution of hard soap to which strong ammonia has been added. The best proportions are 1½ lb. of hard curd soap, 50 lb. of soft water and 2-3 lb. of strong ammonia solution. The same object may be attained in a shorter time by placing the flannel for a quarter of an hour in a weak solution of bisulphite of sodium to which a little hydrochloric acid has been added.

2.—*Ironing.*—Most flannels are the better for not being ironed, but in some cases it is necessary to do so. The proper way is to dry the flannels, then spread them on an ironing board, cover them with a slightly damp cloth, and iron over this, pressing down heavily. The iron must not be too hot.

3.—*Shrinking.*—New flannel should always be washed, before it is made up, in clean warm water, as warm as the hand can bear, and entirely by itself. Rub the soap to a lather in the water, or the flannel will become hard. Wash it in this manner through two warm waters, rinse it in another warm water, with just sufficient soap in it to give it a whitish appearance; to this water add a little indigo blue; wring and shake it well, and while drying shake, stretch and turn it several times. Flannel washed in this manner will be white and soft as long as it lasts. When dry let it be clapped and stretched with the hands, and rolled tight and smooth till wanted.

4.—*Washing.*—To wash flannel or flannel garments, prepare a good lather in hot water; when just warm throw in your flannel, and work it up and down, backward and forward. Ccrubbing must be avoided, and no soap should be actually rubbed on it, as this will induce further shrinkage. Rinse in warm water, twice if necessary. Never wash or rinse in hot or cold water, as they both cause the flannel to shrink suddenly.

Floors.

1.—**W. O. Owen** (*Cin. Lancet-Clinic*) thinks soap and water are far from being an ideal cleansing agent. It cleanses the upper surface, but every crack and crevice is filled with debris to its full capacity, and every hole through the floor is shown below by a pile of dirt or a streak of dirt along the wall below. He has a photograph taken beneath a floor where such debris exceeded a peck in amount, and he has seen others as bad. Moreover, there is an odor of wet wood—rather an odor due to the decomposition of this organic accumulation. The moisture and heat make it an ideal place for germ growth. In the hospital at Fort Thomas he has adopted the following method: They were first cleanel as thoroughly as possible with soap and water, allowed to dry, then gone over with coarse sandpaper to remove splinters, etc., the cracks filled with putty, a wood filler applied, and after this a coat of floor finish. When this was hard it was, in its turn, sandpapered, and then the final coat of floor finish applied. No water should then be applied, except to remove mud or other adherent material. Dr. Owen has found the following composition satisfactory: Wax, 5 lb.; linseed oil, 2 gal.; turpentine, 2 gal.; floor finish (Permanere), 1 gal.; benzine, 10 gal. Melt the wax in the oil at as low a temperature as possible, remove from the fire, add the turpentine and floor finish, take the liquid out of the house and add the benzine. If the wax and oil are heated too much the mixture is not so soluble in the benzine. Less oil and more wax will perhaps be a better composition. The method of application that has given the best results is this: After the heavy part of the day's work is done the floor is brushed thoroughly with a floor brush and the liquid is as evenly and thinly as possible applied with an old piece of cotton cloth to the already polished floor. It is then left for 12 hours, when it is again brushed and polished with a cotton mop. The brush removes all of the heavier particles of dirt and the mop the finer. The result is that the house and floors become thoroughly dry, the woodwork retains its original color and finish, the work of your help is reduced fully one-half, and the floors are much cleaner than it is possible to get them with soap and water. The cotton mops become rapidly soiled. They may be cleaned by boiling in a weak solution of soda or potash. They cost ten cents apiece. Some care must be exercised on account of the danger of fire, but this danger is slight with reliable help.

2.—Take some clean, sifted, white or silver sand, and scatter it on the floor. Dissolve 1 lb. of American potash or pearlash in 1 pt. of water, and sprinkle the sand with this solution. Have a pail of very hot water, and well scrub the boards lengthwise with a hard brush, and use the best mottled soap. Change the water frequently. This is the best way to scour and whiten boards. The potash, if applied as directed, will take out all stains. Ink stains may be removed from boards by using either strong vinegar or salts of lemon.

3.—The following will be found useful in cleaning and restoring color to wooden floors: Calcinated soda, 1 part, allowed to stand ¾ hour in 1 part of slaked lime; then add 15 parts of water, and boil. Spread the solution, thus obtained, upon the floor with a rag, and, after drying, rub with a hard brush and fine sand and water. A solution of 1 part of concentrated sulphuric acid and 8 parts of water will enliven the wood after above application. When dry, wash and wax the floor.

4.—*Ink Spots on Floors.*—Rub with sand wet with equal parts of water and oil of vitriol; when ink is removed rinse with weak lye water. In place of oilcloth, tack down an old Brussels carpet, wrong side up; give it 2 coats of paint, and, when thoroughly dry, varnish.

5.—*Oil Stains, To Remove.*—Use oxalic acid and water, then wash well with soda and soap.

6.—*Paint, To Remove.*—Take 1 lb. of American pearlash and 3 lb. of quick stone lime; slake the lime in water, then add the pearlash, and make the whole about the consistency of paint. Lay the mixture over the whole body of the work which is required to be cleaned, with an old brush; let it remain for 12 or 14 hours, when the paint can be easily scraped off.

7.—*Parquet Floors.*—To remove grease spots from parquet floors rub the spot with soft soap thoroughly, pour some strong alcohol on to it, and light it, taking the proper precautions. Do not allow the clothing to come too close to the flames. After the flames are extinguished scour several times thoroughly with very hot water; the spot will then certainly have disappeared.

8.—*Scouring.*—Clean sand, 12 parts; soft soap, 8 parts; lime, 4 parts. Use a scrubbing brush, and rinse.

9.—*Waxed Floors, To Remove Grease.*—Cover with turpentine for an hour or two. Cover with powdered talc, and press with a warm iron. Brush off the talc; if spot has disappeared, rub with wax; if not, repeat the process.

Fringe, Bullion and Worsted.

Dissolve 1 bar of soap in 4 gal. of boiling water; have 3 vessels, each containing 2 gal. of cold water. Into the first of these put 2 gal., into the second 1½ gal., and into the third 1 gal. of the dissolvd soap. Tack the fringe end to end, and then put it into the first soap liquor; work it well in this, then put it into the second liquor, and again well work it; now put it into the third liquor, handle it well in this, and afterward put it on a clean peg to drain. Put 8 gal. of cold water into a clean vessel, and stir into it 1 tablespoonful of oil of vitriol; handle the fringe in this spirit water for 5 minutes, take it out, and rinse it in 1 lot of cold water for about 1 minute. If the fringe contains any spickets—that is, pieces of wood covered with silk—these must be taken off and cleaned with bread crumbs and camphine; or, if necessary, sent to the fringe makers to be recovered.

Fruit and Wine Stains.

1.—White cotton or linen, fumes of burning sulphur, warm chlorine water. Colored cottons or woolens, wash with tepid soapsuds of ammonia. Silks, the same, with very gentle rubbing.

2.—First rub the spot on each side with hard soap and then lay on a thick mixture of starch and cold water. Rub this mixture of starch well into the spot, and afterward expose it to the sun and air. If the stain has not disappeared at the end of 3 or 4 days repeat the process.

3.—Stains of wine may be quickly and easily removed from linen by dipping the parts which are stained into boiling milk. The milk to be kept boiling until the stain disappears.

4.—Most fruits yield juices which, owing to the acid they contain, permanently injure the tone of the dye; but the greater part may be removed without leaving a stain if the spot be rinsed in cold water in which a few drops of aqua ammonia have been placed, before the spot has dried. Wine stains on white materials may be removed by rinsing with cold water, applying locally a weak solution of chloride of lime, and again rinsing in an abundance of water. Some fruit stains yield only to soaping with the hand, followed by fumigation with sulphurous acid; but the latter process is inadmissible with certain colored stuffs. If delicate colors are injured by soapy or alkaline matters, the stains must be treated with colorless vinegar of moderate strength.

5.—To remove fruit and wine stains

from table linen, moisten with dilute sulphuric acid and then rub with an aqueous solution of sulphite or hyposulphite of soda in water.

6.—Spread the stained part over a bowl or basin, and pour boiling water through it; or rub on salts of lemon, and pour boiling water through until the stain disappears or becomes very faint.

Fuller's Earth, White.

Fuller's earth, in powder, 2 lb.; talc, in powder, 12 lb.; violet powder, 2 lb. Mix.

Fur.

1.—Soap or water will spoil it. Get some clean common whiting—powdered, and plenty of it—put it in a damp place for a day or so, but on no account let it get wet; rub it into the fur with the hand, and don't be afraid to rub it. Now let it stop till next day, give it another good rubbing, then shake out all the whiting you can, and give it a good brushing with a clothes brush. It will now be pretty clean, except the skin at the bottom of the fur. To remove the dirt from this get the fur over the back of the chair, and use the point of the clothes brush very briskly, at the same time giving a short puff of wind every time you give a stroke with the brush. With a little practice you will remove every trace of whiting, grease or dirt. Lastly, pour alcohol on a plate, dip the point of the clothes brush in this, and lightly pass it over the fur; move the brush the same way as the fur runs.

2.—Take equal parts of flour and powdered salt (which should be well heated in an oven), and thoroughly rub the fur. It should afterward be well shaken to free it from the flour and salt.

3.—Lay the fur on a table, and rub it well with bran made moist with warm water. Rub until quite dry, and afterward with dry bran. The wet bran should be put on with flannel, and the dry with a piece of book muslin.

4.—Thoroughly sprinkle every part with hot plaster of paris, and brush well with a hard brush. Then beat it with a cane, comb smooth with a wet comb, and press carefully with a warm iron; when dry, shake out all loose plaster of paris.

5.—Make a thin paste by adding benzoline to light carbonate of magnesia. Cover the fur with this thoroughly, hang it out in the open air to dry, then shake and brush it until the whole of the powder has been removed.

Gas Fixtures. (See also **Brass.**)

1.—*Cleansing.*—It is very rarely that gas brackets are gilded with real gold; they are either dipped or lacquered. To cleanse, whether gilded with gold or only its imitation, they must be taken apart and the separate parts boiled in a strong lye for a few minutes and brushed with a soft brush. Then pass through a solution of cyanide of potassium; after this, wash in boiling water, and after drying in sawdust, polish parts with chamois leather. When putting them together again the parts should, if it be necessary, be freshly varnished.

2.—*Refinishing.*—Gas fixtures which have become dirty or tarnished from use may be improved in appearance by painting with bronze paint, and then, if a still better finish is required, varnishing after the paint is thoroughly dry with some light-colored varnish that will give a hard and brilliant coating. If the bronze paint is made up with ordinary varnish it is liable to become discolored from acid which may be present in the varnish. One method proposed for obviating this is to mix the varnish with about 5 times its volume of spirit of turpentine, add to the mixture dried slaked lime in the proportion of about 40 gr. to the pint, agitate well, repeating the agitation several times, and finally allowing the suspended matter to settle, and decanting the clear liquid. The object of this is, of course, to neutralize any acid which may be present. To determine how effectively this has been done, the varnish may be chemically tested.

3.—*Polishing.*—Pickle, and while in the lathe dip the burnisher in the following liquid: Turmeric root 60 parts; orange shellac, 60 parts; dissolved in alcohol tartar, 120 parts; oxgall, 3 parts; alcohol, 6 parts; water, 180 parts; dry with a soft cloth.

Gas Stove.

Every housewife is more or less annoyed by the facility with which the top of her gas stove becomes soiled, if not, indeed, clogged with spatterings of grease. An easy method of removing this will be very acceptable, no doubt. It is well to immerse the separable parts for several hours in a warm lye, heated to about 70° C, said lye to be made of 9 parts of caustic soda and 180 parts of water. These pieces, together with the fixed parts of the stove, may be well brushed with this lye and afterward rinsed in clean warm water. The grease will be dissolved away, and the stove returned almost to its original purity.

German Silver, To Polish.

Take 1 lb. of peroxide of iron, pure, and put half of it into a wash basin, pouring on water, and keeping it stirred until the basin is nearly full. While the water and crocus are in slow motion, pour off, leaving grit at the bottom. Repeat this a second time, pouring off into another basin. Cleanse out grit, and do the same with the other half. When the second lot is poured off the crocus in the first will have settled to the bottom; pour off the water gently, take out the powder, dry it, and put both, when washed clear of grit, and dried, into a box into which dust cannot get. If the silverwork is very dirty, rub the mixture of powder and oil on with the fingers, and then it will be known if any grit is on the work. If the work is not very black, take a piece of soft chamois leather and rub some dry crocus on, and, when well rubbed shake out the leather and let the powder fall off that is not used, or rub it off with a brush. Do not put down the leather in the dust.

Gilt Mountings and Frames.

1.—Fly marks can be cleaned off with soap and water, used sparingly on end of finger covered by piece of rag. When all cleared off, rinse with cold water, and dry with chamois leather; next buy 1 lb. of common size and 2 small paint pans. Boil a little of the size in one of the pans, with as much water as will just cover it. When boiled, strain through muslin into clean pan, and apply thinly to frames with camel's-hair brush (called, technically, a "dabber") Take care you do not give the frames too much water and "elbow grease." On no account use gold size, as it is used only in regilding, and if put on over the gold would make it dull and sticky.

2.—Dissolve a very small quantity of salts of tartar in a wine bottle of water, and with a piece of cotton wool soaked in the liquid dab the frames very gently; no rubbing, on any account, or you will take off the gilt; then stand up the frames so that the water will drain away from them conveniently, and syringe them with clean water. Care must be taken that the solution is not too strong.

3.—If new gold frames are varnished with the best copal varnish it improves their appearance considerably, and fly marks can then be washed off carefully with a sponge. The frames also last many times longer. It also improves old frames to varnish them with it.

4.—Gilt frames may be cleaned by simply washing them with a small sponge moistened with hot spirits of wine or oil of turpentine, the sponge only to be sufficiently wet to take off the dirt and fly marks. They should not afterward be wiped but left to dry of themselves.

5.—Old ale is a good thing to wash any gilding with, as it acts at once upon the fly dirt. Apply it with a soft rag; but for the ins and outs of carved work a brush is necessary; wipe it nearly dry, and don't apply any water. Thus will you leave a thin coat of the glutinous isinglass of the finings on the face of the work, which will prevent the following flies' faeces from fastening to the frame as they otherwise would do.

6.—Mix and beat the whites of 3 eggs with one-third, by weight, of Javelle water and apply to the gilt work, which will be quickly restored to newness.

7.—Gilt mountings, unless carefully cleaned, soon lose their luster. They should not be rubbed; if slightly tarnished, wipe them off with a piece of Canton flannel, or, what is better, remove them, if possible, and wash in a solution of ½ oz. of borax, dissolved in 1 lb. of water, and dry them with a soft linen rag; their luster may be improved by heating them a little and rubbing with a piece of Canton flannel.

8.—(Upton.) Quicklime, 1 oz.; sprinkle it with a little hot water to slake it, then gradually add 1 pt. of boiling water, so as to form a milk. Next, dissolve pearlash, 2 oz., in 1½ pt. of boiling water. Mix the 2 solutions, cover up the vessel, agitate occasionally for an hour, allow it to settle; decant the clear, put it into flat ½-pt. bottles, and cork them well. Use to clean gilding, either alone or diluted with water. It is applied with a soft sponge, and then washed off with clean water. It is essentially a weak solution of potassa, and may be extemporaneously prepared by diluting solution of potassa with about 5 times its volume.

Glass.

For removing any sort of dirt that is insoluble in water, lye, and dilute acids, from hollow vessels, a great variety of mechanical means are employed, such as iron chains and balls, sand, shot, hand and machine brushes. The selection is governed less by the quality of the filth than by economical considerations, such as the cost of the material used, of hand labor, the wear and tear on the vessel, etc.

For cleansing glass vessels, river and sea sand are inadmissible because hard quartz sand, especially angular river sand, scratches the glass, and gradually renders it opaque, if it does not previously crack where the scratches occur, on the principle of the Bologne flask and Prince Rupert drops.

1.—Adherent slime and sediment are removed, especially from valuable glasses, by shaking with bits of paper or linen rags.

2.—A substitute for sand for household use is found in calcined ashes and coarse salt.

3.—Clean wood ashes, mixed with pieces of charcoal, can be strongly recommended, and they act chemically, too, owing to the potash they contain. Coal ashes, and those from peat, are worthless, because they are mixed with sharp sand.

4.—Ordinary salt is less useful for cleansing than coarse sea salt or ground rock salt. Where the resulting brine can be utilized, as in agriculture, etc., salt can be recommended for scouring purposes:

5.—As scouring material in large establishments we can recommend gypsum and marble dust, free from sand and also ground bones. In the manufacture of bone meal, from the stronger and more resistant (tubular) bones, there is an intermediate product, about the size of barley grains (knochen-graupen), that is excellent for cleansing bottles. Many bone mills now furnish this product, but it has found little favor as yet.

6.—Marble and gypsum dust are, in general, less sure to be free from quartz; and besides, the latter dissolves to some extent in water, and, if used, must be well rinsed out afterward.

7.—The India-rubber washer is useful in analytical laboratories, where it is required to collect and save the sediments, as in filtering precipitates, etc. Chisel or tongue-shaped places are cut from thick pieces of India-rubber, and a sharp brass or platinum wire is fixed into the thick end to serve as a handle. For beakers and capsules it is to be preferred to the hair pencil and feather commonly used, for owing to their fibrous structure, the precipitate gets entangled in them, while they also lose some of their nitrogeneous particles, which would affect the accuracy of careful nitrogen determination, as, for example, in water analysis.

8.—To cleanse glass or porcelain vessels very thoroughly from the greatest variety of adherent organic substances, the mixture of bichromate of potash and sulphuric acid possesses an indisputable advantage over benzine, ether, alcohol, etc. Always keep a stock of this chromic and sulphuric-acid mixture, made from the acid of the desiccator, and the chromate from the nitric-acid estimations, and use it for rinsing graduated vessels, which are then more easily moistened.

9.—If greasy, wipe with tow, then with nitric acid or caustic potash; rinse well.

10.—*Cover Glasses.*—There is, says Mr. F. W. Cooper, in the *Photogram*, nothing better than a piece of chamois leather or velveteen, stretched over a board (2 ft. by 5 in. by ¾ in.), and tacked to the under side, a piece of stout twill being interposed between the board and the velvet. The glasses having been cleaned, and merely drained, can be very quickly and perfctly polished by rubbing up and down the leather or velvet surface. The board has the advantage of obviating any risk of cutting the hands or breaking the glasses as when polishing is done with a duster and the glass held in the hand.

11.—*Cut Glass.*—A high polish may be given to cut-glass dishes, decanters, etc., by sprinkling with warmed sawdust directly after washing and drying in the usual way. A very soft chamois leather must give the final polish, and this should be kept free from dust and for the one purpose only.

12.—*Discolored Glass.*—Apply dilute nitric acid. Water of ammonia is also good.

13.—*Framed Glass.*—To clean glass in frames, when the latter are covered, or otherwise so finished that water cannot be used, moisten tripoli with brandy, rub it on the glass while moist, and when dry rub off with a silk rag; to prevent the mixture injuring the cloth on the frame, use strips of tin bent to an angle; set these on the frame with one edge on the glass; when the frames are of a character that will not be injured by water, rub the glass with water containing a little liquid ammonia, and polish with moist paper.

14.—*Globes.*—In order to remove from lamp globes the unsightly grease spots frequently met with, and to restore the handsome matt appearance of polished glass, pour 2 spoonfuls of a slightly heated solution of potash into the globe, moisten the whole surface with it, and rub the stains with a fine linen rag; rinse the globe with clean water, and carefully dry it off with a fine soft cloth.

15.—*Paint Stains.*—a.—American pot

ash, 3 parts; unslaked lime, 1 part. Lay this on with a stick, letting it remain for some time, and it will remove either tar or paint.

b.—Common washing soda dissolved in water. Let it soak a while—if put on thick, say 30 minutes—and then wash off. If it does not remove, give it another application.

16.—*Photographic Plates.*—Photographers will find the following a useful glass-cleaning preparation: Water, 1 pt.; sulphuric acid, ½ oz.; bichromate of potash, ½ oz. The glass plates, varnished, or otherwise, are left for 10 or 12 hours, or as much longer as desird, in this solution, then rinsed in clean water and wiped dry with soft white paper. The liquid quickly removes silver stains from the skin without any of the attendant dangers of cyanide of potassium.

17.—*Polish.*—Sodium carbonate, 1 oz.: powdered whiting, 4 oz.; stronger ammonia water, 1 oz.; alcohol, 4 oz.; water, enough to make 1 pt. Mix well, and apply with a sponge. When it is dry, rub off and polish. Of course, nothing should be used in polishing glass that will scratch it.

Simple diluted ammonia water is a good cleanser for glassware, especially if the article is a little greasy.

18.—*Scratches.* — a. — Slight scratches may be partially polished out by rubbing the part with rouge wet with water, upon a piece of soft leather. If it is a deep scratch, it will have to be ground out with the finest flour emery, such as is used by opticians, and the spot polished with rouge and water upon a piece of soft leather. If you have much of this kind of work to do it will save time to set up a buff wheel of wood, and grind out the scratches with fine pumice stone and water. Then polish with a felt buff and rouge with water.

b.—When scratches are not too deep they may be removed, and the surface restored, by rubbing with the following powder: Powdered chalk, 60 parts; tripoli, 30 parts; bole, 15 parts. Reduce to a fine powder, and mix. Wet the surface of the article slightly with water; then, with a linen cloth dipped in the powder, rub the surface until the dullness disappears.

Goatskin Rugs.

One washing with warm (not hot) suds will not materially hurt the skin itself. The skin may not seem quite so soft after the washing, but if the washing is done quickly, the skin well rinsed in cold water, and dried with only moderate warmth, being frequently turned and shaken, the difference with hardly be perceptible.

Gloves.

1.—Soft, soap, 1 oz.; water, 4 oz.; oil of lemon, ½ dr.; precipitated chalk, a sufficient quantity. Dissolve the soap in the water, add the oil, and make into a stiff paste with a sufficient quantity of chalk.

2.—White hard soap, 1 part; talcum, 1 part; water, 4 parts. Shave the soap into ribbons, dissolve in the water by the aid of heat, and incorporate the talcum.

3.—White bole, 600 parts; orris root, 300 parts; dry soap, 75 parts; borax, 150 parts; ammonium chloride, 25 parts. Powder and mix thoroughly. Dampen the gloves with a wet rag, dust on the powder, and then rub it well in. When dry, brush off the residual powder.—*Druggists' Circular.*

4.—Chloroform, 1 fl.dr.; alcohol, 2 fl.dr.; ammonia water, 10 fl.dr.; sodium carbonate, 2 dr.; Castile soap, 1 oz.; water, 4 pt.

5.—Stronger ammonia water, 2 fl.dr.; glycerine, 1 fl.oz.; ether, 1 fl.oz.; Castile soap, 1 fl.oz.; water, 2 pt.

6.—Castile soap, 1 oz.; borax, 1 oz.; soap liniment, 12 fl.dr.; alcohol, 2½ fl.oz.; ammonia water, 4 fl.oz.; boiling water, 3 pt.

7.—Curd soap, 1 av.oz.; water, 4 fl.oz.; oil of lemon, ½ fl.dr.; French chalk, a sufficient quantity. Shred the soap, and melt it in the water by heat; add the oil of lemon, and make into a stiff paste with French chalk.

8.—White soap, 25 parts; water, 15 parts; solution of chlorinated soda, 16 parts; ammonia water (10%), 1 part. Shred the soap, and melt it in the water by heat stirring well all the time; when lukewarm add the other liquids, and mix thoroughly. Put the glove on the hand and apply the paste with a piece of flannel, rubbing the kid from wrist to finger tips.

9.—Castile soap, white, old and dry, 100 parts; water, 75 parts; tincture of quillaia, 10 parts; ether, 10 parts; ammonia water, stronger, 5 parts; benzine, deodorized, 75 parts. Melt the soap, previously finely shaved, in the water, bring to boiling, and remove from the fire. Let cool, then add the other ingredients, incorporating them thoroughly. The paste should be put up in collapsible tubes, or tightly closed metallic boxes. It can also be used for clothing.

10.—Kaolin, 8 oz.; talcum, 4 oz.; borax, 2 oz.; soap, 1 oz.; ammonium chloride, 4 dr. A powder to be applied with a damp cloth.

11.—Ether, 1 part; benzol, 2 parts. Put the gloves on the hands and rub thoroughly with the solution, with a clean piece of flannel. Let the greater part of the fluid evaporate, then remove the gloves from the hands and hang them in a current of warm, dry air until the smell of the liquid is dissipated.

12.—Tincture of quillaia, 3 oz.; benzine, 13 oz. Mix, and shake for half an hour, then set aside for 12 hours to solidify.

13.—Hard white soap, 3 oz.; boiling water, 5 oz.; stronger ammonia water, 8 oz.; benzine, 26 oz. Dissolve the soap in the water, and when nearly cold add the ammonia and the benzine. This may be perfumed with any suitable oil or "essence."

14.—The following from Dieterich is said to be especially excellent: Tincture of quillaia, 10 parts; sulphuric ether, 10 parts; ammonia water, 3 parts; oil of lavender, 0.5 part; deodorized benzine, q. s. to make 100 parts. Mix. Shake before using.

15.—Plain benzine, with ½ part each of oil of mirbane and oil of lavender, makes, according to one authority, the best of all cleaners.

16.—*Doeskin, Wash Leather (Chamois), and Undressed Kid.*—a.—Wash them in lukewarm soft water, with a little Castile or curd soap, oxgall or bran tea; then stretch them on wooden hands, or pull them into shape without wringing them; next rub them with pipeclay, yellow ocher, or umber, or a mixture of them in any required shade, made into a paste with ale or beer; let them dry gradually, and when about half dry rub them well, so as to smooth them and put them into shape; when they are dry brush out the superfluous color, cover them with paper, and smooth them with a warm (not hot) iron.

b.—Take out the grease spots by rubbing them with magnesia or with cream of tartar. Then wash them with soap dissolved in water as directed for kid gloves, and afterward rinse them, first in warm water and then in cold. Dry them in the sun, or before the fire. All gloves are better and more shapely if dried on glove trees or wooden hands.

Gold. (See also **Gilt Mountings and Frames.**)

1.—*Dull Gold.*—A solution of 80 grams of chloride of lime, 80 grams of bicarbonate of soda, and 20 grams of common salt, in 3 l. of distilled water, is prepared, and kept in well closed bottles. The article to be cleaned is allowed to remain some short time in this solution (which is only to be heated in the case of very obstinate dirt), then taken out, washed with spirit, and dried in sawdust.

2.—*Matt Gold.*—Take 80 grams of chloride of lime and rub it up with gradual addition of water, in a porcelain mortar, into a thin, even paste, which put into a solution of 80 grams of bicarbonate of soda and 20 grams of cooking salt, in 3 l. of water. Shake it, and let stand a few days before using. If the preparation is to be kept for any length of time the bottle should be placed, well corked, in the cellar. For use, lay the tarnished articles in a dish, pour the liquid, which has previously been well shaken up, over them so as to just cover them, and leave them therein for a few days. In very stubborn cases one may dilute somewhat. Next wash the objects, rinse with alcohod, and dry in sawdust.

3.—*Tarnished Gold.*—This preparation is made up by carefully mixing together 20 parts of bicarbonate of soda, 1 part of calcium chloride and 1 part of common salt in 16 parts of water. Of this, a small quantity is spread upon the surface to be cleansed with a soft brush, and afterward rubbed well with a piece of tissue paper until it is perfectly dry. The liquid may be applied either lukewarm or cold, according to convenience.

4.—Use rouge on a buff moistened with alcohol.

5.—Use jewelers' rouge with a brush.

6.—Chalk, 18 parts; mixed with talc, 5 parts; silica, 2 parts; alumina, 5 parts; carbonate of magnesia, 2 parts; jewelers' red, 2 parts.

7.—Rock alum, burned and finely powdered, 5 parts; levigated chalk, 1 part; mix, and apply with a dry brush.

8.—The *Journal fur Goldschmiedekunst* gives the following formula for a preparation for cleaning and polishing gold, silver and plated were: Acetic acid, 2 parts; sulphuric acid, 2 parts; oxalic acid, 1 part; jewelers' rouge, 2 parts; distilled water, 200 parts. Mix the acids and water and stir in the rouge, after first rubbing it up with a portion of the liquid. With a clean cloth, wet with this mixture, go well over the article. Rinse off with hot water, and dry.

3.—A powder of somewhat similar composition is said to be used by gold and silversmiths, the formula for which follows: Chalk, 54 parts; magnesium carbonate, 5 parts; alumina, 14 parts; silica, 8 parts; iron oxide, 5 parts.

Gold and Silver Lace.

Gold lace, spangles, clasps, knots, etc., may be brushed over with the following composition: Shellac, 1½ oz.; dragon's blood, ½ dr.; turmeric root, ½ dr.; digest with strong alcohol, decanting the ruby-red colored tincture thus obtained. After coating with this composition a warm flat-iron is gently brushed over the objects so as to heat them only very slightly. Gold embroidery can be similarly treated. Silver lace or embroidery may be dusted over with the following powder and well brushed: Take alabaster, and strongly ignite it and while still hot place it in corn brandy; a white powder is thus obtained, which is fit for use after heating over the flame of a spirit lamp. It should be dusted on from a linen bag.

Gold Workers, Polishing Powders for.

Carbonate of lead, 21½ parts; carbonate of lime (chalk), 87 parts; carbonate of magnesia, 8½ parts; alumina, 21½ parts; silica, 13 parts; jewelers' rouge, 8½ parts. Mix together.

Granite, Removal of Stains.

1.—A paste of oxgall, 1 oz.; strong solution of caustic soda, 1 gill; turpentine, 1½ tablespoonfuls; pipeclay, enough to make it thick and consistent. Scour well.

2.—Mix together whiting, ¼ lb.; soft soap, ¼ lb.; washing soda, 1 oz.; sulphate of soda, a piece as big as a walnut. Rub it over the surface you propose to treat, let it stand 24 hours, and then wash off. If it succeeds, try another portion.

3.—Smoke and soot stains can be removed with a hard scrubbing brush and fine sharp sand, to which add a little potash.

4.—Use strong lye, or make a hot solution of 3 lb. of common washing soda dissolved in 1 gal. of water. Lay it on the granite with a paint brush.

Grass Stains.

garment is otherwise wet.
oring matter of grass—cholorophyll—is
soluble.
cold soft water, without soap, before the
2.—Remove by ether, in which the col-
1.—Wash the stained places in clean,

Grease and Stains.

1.—When the fabric is washable and the color fast, ordinary soap and water are, of course, efficient in removing grease and the ordinarily attendant dirt; but special soaps are made for clothes cleaning which may pssibly be more effective.

2.—In the removal of grease from clothing with benzol or turpentine, people generally make the mistake of wetting the cloth with the turpentine and then rubbing it with a sponge or piece of cloth. In this way the fat is dissolved, but is spread over a greater space, and is not removed; the benzol or turpentine evaporates, and the fat covers a greater surface than before. The way is to place soft blotting paper beneath and on top of the grease spot, which is to be first thoroughly saturated with the benzol, and then well pressed. The fat is then dissolved, and absorbed by the paper, and entirely removed from the clothing.

3.—Another method, namely, to apply a hot iron on one side, while blotting paper is applied to the other, depends upon the fact that the surface tension of a substance diminishes with a rise of temperature. If, therefore, the temperature at different portions or sides of the cloth is different, the fat acquires a tendency to move from the hotter parts toward the cooler.

4.—Castile soap, in shavings, 4 oz.; carbonate of soda, 2 oz.; borax, 1 oz.; aqua ammonia, 7 oz.; alcohol, 3 oz.; sulphuric ether, 2 oz.; soft water, enough to make 1 gal. Boil the soap in the water until it is dissolved, and then add the other ingredients. Although it is not apparent what good 2 oz. of ether can do in 1 gal. of liquid, the mixture is said to be very efficient.

5.—Make a weak solution of ammonia by mixing the ordinary "liquor ammoniae" of the druggist with its own volume of cold water, and rub it well into the greasy parts, rinsing the cloth in cold water from time to time until the grease is removed. The ammonia forms a soap with the fatty acids of the grease, which is soluble in water.

6.—Strong ammonia water, 4 oz.; water, 2 qt.; saltpeter, 1 oz.; mottled soap, finely shaved, 2 oz. Mix thoroughly, and allow the preparation to stand for several days before using. Cover any grease spot with this preparation, rub well, and rinse with clean water.

7.—Camphor, 1 oz., dissolved in 3 oz. of alcohol; add 4 oz. of esesnce of lemon.

8.—Camphine, 8 oz.; alcohol, 1 oz.;

sulphuric either, 1 oz.; essence of lemon, 1 dr.

9.—Alcohol, 8 oz.; white soap, 1½ oz.; oxgall, 1½ oz.; essence of lemon, ⅛ to ¼ oz.

10.—Fuller's earth, 15 parts; French chalk, ½ part; yellow soap, 10 parts; pearlash, 8 parts; mix thoroughly, and make it into paste with spirits of turpentine. Color, if desired, with yellow ocher. Form into cakes.

11.—An earthy empound for removing grease spots is made as follws: Take fuller's earth, free it from all gritty matter by eluttriation with water; mix with ½ lb. of the earth so prepared ½ lb. of soda, as much soap, and 8 yolks of eggs, well beaten up, with ½ lb. of purified oxgall. The whole must be carefully triturated upon a porphyry slab, the soda with the soap in the same manner as colors are ground, mixing in gradually the eggs and the oxgall, previously beaten together. Incorporate next the soft earth by slow degrees till a uniform thick paste be formed, which should be made into balls or cakes of a convenient size, and laid out to dry. A little of this detergent being scraped off with a knife, made into a paste with water, and applied to the stain, will remove it.

12.—Castile soap, 4 oz.; hot water, 1 qt. When the soap is dissolved add water, 4 qt.; water of ammonia, 4 fl.oz.; sulphuric ether, 1 fl.oz.; glycerine, 1 fl.oz.; alcohol, 1 oz. *Medical Brief* states that this is an excellent preparation for removing grease.

13.—A soft oxgall soap may be prepared as follows: Oxgall, fresh, 10 grams; alcohol, 100 grams; hard soap, 10 grams; soft soap, 10 grams. Boil the oxgall in the alcohol, and strain the mixture; dissolve the soaps in this spirit, and evaporate to the proper consistency on a water bath.

14.—Castile soap, 4 dr.; chloroform, 4 dr.; ammonia water, 1 oz.; alcohol, 4 dr.; water, enough to make 8 oz. The mixture blows the stopper out of the bottle.

The claims of carbon tetrachloride as a grease eradicator should not be overlooked. It is said to be equal to benzine for this purpose, and is non-inflammable. It acts as an anesthetic, and must be handled with care.

15.—Powdered borax, 30 parts; extract of soap bark, 30 parts; oxgall, fresh, 120 parts; Castile soap, 450 parts. First make the soap-bark extract by boiling the crushed bark in water until it has assumed a dark color, then strain the liquid into an evaporating dish, and by the aid of heat evaporate it to a solid extract; then powder, and mix it with the borax and the oxgall. Melt the Castile soap by adding a small quantity of water and warming, then add the other ingredients, and mix well. About 100 parts of soap bark make 20 parts of extract.

16.—Castile soap, 2 lb.; potassium carbonate, ½ lb.; camphor, ½ oz.; alcohol, ½ oz.; ammonia water, ½ oz.; hot water, ½ pt., or sufficient. Dissolve the potassium carbonate in the water, add the soap, previously reduced to thin shavings, keep warm over a water bath, stirring occasionally until dissolved, adding more water if necessary, and finally, when of a consistency to become semi-slid on cooling, remove from the fire, and when nearly ready to set, stir in the camphor, previously dissolved in the alcohol, and the ammonia. If a paste is desired, a potash soap should be used instead of the Castile in the foregoing formula, and a portion or all of the water omitted. Soaps made from potash remain soft, while soda soaps harden on the evaporation of the water which they contain when first made. A liquid preparation may be obtained by the addition of sufficient water, and some more alcohol would probably improve it.

17.—A strong decoction of soap bark, preserved by the addition of alcohol, would also form a good liquid cleanser for fabrics of the more delicate sort.

18.—Wood alcohol, 1 gal.; ether, 1 oz.; chloroform, 1 oz.; oil of bergamot, 1 dr.; essential oil of almonds, 10 drops. Mix them. To be applied with a sponge or soft cloth.

19.—Gasoline, 1 gal.; chloroform, 1 oz.; bisulphide of carbon, 1 oz.; essential oil of almonds, 5 drops; oil of bergamot, 1 dr.; oil of cloves, 5 drops. Mix them. To be applied with a sponge or soft cloth. Gloves are best cleaned on the hand. This preparation should not be made or used at night, or in a room where there is a fire, as it is very inflammable. It will not stain nor discolor.

20.—Glycerine, 1 oz.; sulphuric ether, 1 oz.; alcohol, 1 oz.; ammonia, 4 oz.; Castile soap, 1 oz.; mix together, and add sufficient water to make 2 qt. Apply, and rinse.

21.—Take 22 lb. of the best white soap and reduce it to thin shavings. Place it in a boiler, together with water, 8.8 lb.; oxgall, 18.25 lb.; cover up, and allow to remain at rest all night. In the morning heat up gently, and regulate it so that the soap may dissolve without stirring. When the whole is homogeneous, and flows smoothly, part of the water having been vaporized, add turpentine, 0.55 lb.; best clear benzine, 0.44 lb.; and mix well. While still in the state of fusion, color with green ultramarine and ammonia, pour into molds, and let stand for a few days before using. The product will be found to act admirably, and the yield is very good indeed.

22.—*Billiard Cloth, etc.*—Grease can be removed from billiard or other cloths by a paste of fuller's earth and turpentine. This should be rubbed upnon the fabric until the turpentine has evaporated, and a white powder remains. The latter can be brushed off, and the grease will have disappeared.

23.—*Cold Method.*—Cocoanut oil, 30 kgm.; soda lye, 38° B., 15 kgm.; potash lye, 20° B., 5 kgm.; "brilliant" green, 200 grams; oil of turpentine, purified, 800 grams; finely pulverized clay, 26 kgm. The clay (kaolin), finely sifted, is first placed in the vat. The coloring matter ("brilliant" green) is rubbed up with a portion of the oil, and the balance of the latter poured in upon the clay, and the two intimately mixed. The colored oil is next added, and all well stirred together. Mix the 2 alkaline solutions, and pour them in a strong stream into the mixture of oil and clay, agitating the latter constantly. Finally, add the turpentine, under constant stirring. The resultant soap is poured into metallic boxes and closely covered. Grease spots in garments are first covered with a little of the paste, well rubbed in. Sponging with warm water afterward removes soap and spot in the most complete manner.

24.—*Scouring Balls.*—a.—Curd soap, 8 oz.; oil of turpentine and oxgall, of each 1 oz. Melt the soap, and when cooled a little stir in the rest, and make it into cakes while warm.

b.—Soft soap and fuller's earth, each 1 lb.; beat them well together in a mortar, and form into cakes. To remove grease, etc., from cloth. The spot, first moistened with water, is rubbed with the cake, and allowed to dry, when it is well rubbed with a little warm water, and afterward rinsed or rubbed off clean.

25.—*Sugar, Glue, Blood, Albumen.*—On white goods, on dyed tissues of cotton and wool, and on silk, simple washing with water.

Gutta Percha.

Bleaching.—1.—Dissolve the gutta percha in 20 times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for 2 days the plaster is deposited, and carries down with it all the impurities of the gutta percha insoluble in benzole. The clear liquid decanted is introduced by small portions at a time into twice its volume of alcohol of 90%, agitating continually. During this operation the gutta percha is precipitated in the state of a pasty mass, perfectly white. The desiccation of the gutta percha thus purified requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberates moisture which it tends to retain.

2.—White gutta percha is obtained by precipitating a solution of ordinary gutta percha in chloroform by alcohol, washing the precipitate with alcohol, and finally boiling it in water, and molding into desired form while still hot.

Cleaning.—This can be done by using a mixture of soap and powdered charcoal, polishing afterward with a dry cloth with a little charcoal on it.

Hands. (See also **Ink.**)

1.—*Aniline Stains.*—Wash with strong alcohol, or, what is more effectual, wash with a little bleaching powder, then with alcohol.

2.—*Nitrate of Silver Stains.*—a.—Paint the blackened parts with tincture of iodine; let remain until the black becomes white. The skin will then be red, but by applying ammonia the iodine will be bleached, leaving white instead of black stains of nitrate of silver.

b.—Nitrate of silver stains may be removed by rubbing them with a weak solution of sulphydrate of ammonium or a strong solution of iodide of potassium.

3.—*Nitric Acid Stains.*—Touch the stains with a solution of permanganate of potassium; wash, rinse in dilute hydrochloric acid, and wash again.

Harness Cleaning.

Unbuckle all the parts, and wash clean with soft water, soap and a brush. A little turpentine or benzine will take off any gummy substance which the soap fails to remove. Then warm the leather, and as soon as dry on the surface apply the oil with a paint brush or a swab. Neatsfoot oil is the best.

Horsehair, Bleaching.

If a pure white horsehair is required, the hair must be white to start with, as yellow or gray horsehair cannot be made pure white. First thoroughly wash in hot soap and water, then rinse well in clean hot water. Allow to soak about 12 hours in a solution of peroxide of hydrogen made alkaline by ammonia. Lastly, wash in clean water, and dry slowly.

Ink and Iron Mold.

1.—Equal parts of cream of tartar and citric acid, powdered fine, and mixed together. This forms the salts of lemon as sold by druggists. Directions for using: Procure a hot dinner plate, lay the part stained in the plate, and moisten with hot water; next rub in the above powder with the bowl of a spoon until stains disappear; then rinse in clean water, and dry.

2.—Place the stained part flat in a plate or dish, and sprinkle crystals of oxalic acid upon it, adding a little water; the stains will soon disappear, when the linen should be well wrung out in 2 or 3 changes of clean water.

3.—Dip the part in boiling water, and rub it with crystals of oxalic acid; then soak in a weak solution of chloride of lime, say 1 oz. to 1 qt. of water. Under any circumstances, as soon as the stain is removed the linen should be thoroughly rinsed in several waters.

4.— The *Journal de Pharmacie d'Anvers* recommends pyrophosphate of soda for the removal of ink stains. This salt does not injure vegetable fiber, and yields colorless compounds with the ferric oxide of the ink. It is best to first apply tallow to the ink spot, then wash in a solution of pyrophosphate until both tallow and ink have disappeared.

5.—Thick blotting paper is soaked in a concentrated solution of axalic acid and dried. Laid immediately on a blot, it takes it out without leaving a trace behind.

6.—To remove ordinary ink (tannogallate of iron) stains, the following treatment is recommended: In many cases, lemon juice will often prove efficacious.

7.—If this fails, try an aqueous solution of oxalic acid, 1 part, to 2 parts of water, and rub well with a soft cloth. Or use a solution of chloride of tin, 1 part, to 3 parts of water; or pure dilute muriatic acid, 1 part, to 10 parts of water. Apply with a camel's-hair brush, and then wash in cold water.

8.—Where the colors of the fabric are affected by the above treatment, moisten the spots with fresh milk and cover with fine salt. This should be done before washing.

9.—If the fabric is fine and delicate, the stained portions may be dipped in melted tallow and then pressed for some time between layers of warm pipeclay.

10.—Try a mixture of 2 parts of cream of tartar and 1 part of powdered alum.

11.—Tartaric acid is also recommended.

12.—Oxalic acid can also be used, but is not recommended, as it is liable to destroy the fibers of the cloth.

13.—Remove by thoroughly and repeatedly moistening the spots with hydrogen dioxide solution containing some ammonia, and then dry, with exposure to light.

14.—*Black Ink Rust.*—On white goods, warm solution of axalic acid; weak muriatic acid. One dyed tissues of cotton, repeated washings with citric acid, if the color is well dyed. Ditto of wool, same; weak muriatic acid, if the wool is of the natural color: On silk, no remedy.

15.—*Bottles.*—For cleaning ink bottles the best and quickest agent is oxalic acid, but it is a violent poison. Try shaking small nails, with water or vinegar, in them, and if this does not answer, use hydrochloric acid, carefully washing out 2 or 3 times after its application.

16.—*Copperplate Prints.*—Paint the spots with a brush dipped in chloride of lime solution until the black spot turns a rusty brown; then wash with water; next put pulverized oxalic acid on the spot. Now, with another brush put a few drops of hydrochloric acid on the oxalic acid. The rusty spot turns yellow, and can be removed by washing with water.

17.—*Copying Inks.*—Violet and other copying inks generally consist of a solution of glue, glycerine (or other hygroscopic substance) and a basic coloring matter. They can generally be removed, or decolorized, by treating with a mixture of alcohol and ammonia .880 (5:1) on silk goods; and on white cotton and linen goods with a dilute solution of caustic soda or a 25% aqueous solution of ammonia.

18.—*Hands.*—a.—Use ammonia water, muriatic acid, and plenty of water, alternately, assisted by pumice stone, if necessary.

b.—For removing marking ink stains, iodine dissolved either with iodide of potassium or in alcohol, is used, followed by aqua ammonia.

19.—*Indelible Ink.*—Stains made from nitrate of silver may be removed by moistening them with a brush dipped in a strong aqueous solution of cyanide of potassium, and then well washing the fabric in water. The cyanide solution is very poisonous.

20.—*India Ink on Clothing.*—India ink cannot be removed by any chemical means, as it is composed of minute parts of carbon held in suspension by water. Some of the ink may be removed by sponging.

21.—*India Ink on Paper.*—To remove a blot, dip a camel's-hair brush in water and rub over the blot, letting the water remain on a few seconds; then make as dry as you can with blotting paper, then rub carefully with India-rubber. Repeat the operation if not all removed. For lines, circles, etc., dip the ink-leg of your instruments in water, open the pen rather wider than the line, and trace over, using blotting paper and India-rubber, as for a blot. Applicable to drawing paper, tracing paper and tracing linen. If the surface is a little rough after, polish with your nail.

22.—*Marking Ink.*—a.—Dissolve 1 oz. of cyanide of potassium in 4 oz. of water. This mixture is very poisonous, and should, therefore, be used with great caution. Moisten the stained part of the garment with this solution by dipping it into it, or by means of a small brush, and in a few hours the stain will be obliterated.

b.—To a solution of strong cyanide of potassium add a few grains of iodine. Repeated applications will remove any stain caused by nitrate of silver.

c.—Grimm, in the *Polytechnisches Notizblatt*, proposes the following method for removing indelible ink and other silver stains without the use of cyanide of potassium: Chloride of copper is first applied to the tissue; it is next washed with hyposulphite of soda solution, and afterward with water. It is said that this may be employed on colored woven cotton tissues. For white cottons and linens, dilute solutions of permanganate of potash and hydrochloric acid, followed by the hyposulphite of soda and clear water, are preferable.

d.—Wet with chloride of lime, and afterward rinse in a little ammonia or sodium of hyposulphite.

e.—Rub with tincture of iodine, then wash with ammonia.

23.—*Paper.*—a.—Take of chloride of lime, 1 lb., thoroughly pulverized, and 4 qt. of soft water. The above must be thoroughly shaken when first put together. It is required to stand 24 hours to dissolve the chloride of lime; then strain through a cotton cloth, after which add a teaspoonful of acetic acid (No. 8 commercial) to every ounce of the chloride of lime water. The eraser is used by reversing the penholder in the hand, dipping the end of the penholder in the fluid and applying it, without rubbing, to the word, figure or blot required to be erased. When the ink has disappeared absorb the fluid with a blotter.

b.—Mix equal parts of oxalic and tartaric acids in powder. When to be used dissolve a little in water. It is poisonous.

c.—Oxalic acid, mixed with citric acid, may be used.

d.—Equal parts of cream of tartar and citric acid in solution with water.

e.—A more powerful one, a saturated solution of oxalic acid in water.

f.—Cold aqueous or acetic acid solution of calcium hypochlorite, bleaching powder or eau de Javelle.

g.—Immerse blotting paper or any similar material in a hot, concentrated solution of citric acid, roll it into a pencil, and coat the larger portion of it with paper or lacquer. Moisten the eraser with water, and rub over the ink to be removed. Drop upon the ink spot a drop of water containing chloride of lime. The ink immediately disappears.

h.—Take alum, 1 part; sulphur, 1 part; amber, 1 part; potassium nitrate, 1 part. Powder, and mix. Keep in well closed vials. A little of this powder, dropped on a fresh ink spot, or fresh writing, and rubbed with a bit of cloth or blotting paper, removes the mark completely.

i.—The following makes a good "two solution" ink remover. Solution A: Citric acid, 1 part; concentrated borax solution, 2 parts; distilled water, 16 parts. Dissolve the acid in the water, add the borax solution, and mix by agitation. Solution B: Calcium chloride, 3 parts; concentrated borax solution, 2 parts; water, 16 parts. Add the calcium chloride to the water, shake well, and set aside for a week, at the expiration of which time decant the clear liquid, and to it add the borax solution. Directions for use: Saturate the spot with solution A, apply a blotter to take off excess of liquid, then apply solution B. When the stain has disappeared, apply the blotter, and wet the spot with clean water. Absorb this with a blotter, and repeat, applying water 2 or 3 times (to remove residual chemicals); finally dry between 2 sheets of blotting paper. Spots removed by this agent never return, and cannot even be brought back by the use of chemicals.

j.—An excellent formula, and one that few inks can resist, is as follows: (1) Mix in equal parts, potassium chloride, potassium hypochlorite and oil of peppermint. (2) Sodium chloride, hydrochloric acid and water, in equal parts. To use: Wet the spot with (1), let dry, then pencil it over lightly with (2), and rinse in clear water.

k.—A good single mixture, which will answer for most inks, is made by mixing citric acid and alum in equal parts. If desired in a liquid form, add an equal part of water. In use, the powder is spread well over the spot and (if on cloth or woven fabrics) well rubbed in with the fingers. A few drops of water are then added, and also rubbed in. A final rinsing with water completes the process.

l.—Blotting paper . which admits of completely removing from paper wet as well as dry ink spots, after moistening with water, is produced as follows: Dissolve 100 parts of oxalic acid in 400 parts of alcohol, and immerse porous white paper in this solution until it is completely saturated with it. Next hang the sheets up, separately, to dry, over threads. Such paper affords great advantages, but its characteristic application is serviceable for ferric inks only, while aniline ink spots cannot be removed with it after drying.

m.—Inking Over Erasures.—A correspondent of *Machinery* writes: "I enclose a piece of tracing cloth which I think would be of interest, as you will notice the lines have been erased in two places, and one of them polished over again, which makes a good surface to ink on, and does not catch the dirt as the unpolished part would. The polish is put on with French chalk or soapstone, and then rubbed down with a good clean white blotter. It is best to split the blotter to insure its being clean, and to have two grades of chalk, one hard and one soft, the latter to be used first, then the hard."

24.—*Printers' Ink.*—a.—Put the stained parts of the fabric into a quantity of benzine, then use a fine, rather stiff brush, with fresh benzine. Dry, and rub bright with warm water and cured soap. The benzine will not injure the fabric or dye.

b.—Place a thick pad of white blotting paper beneath the sheet of paper which is soiled; then apply sulphuric ether with cotton wool, gently rubbing. Finally, apply white blotting paper to absorb the color. Continue the application of fresh ether, and repeat until all stains disappear. Do this away from a light.

c.—Printers' ink is soluble in ether, oil of turpentine and benzine. Washing with warm caustic lyes is also recommended.

d.—This is not an easy matter. It is said, however, that it can be accomplished to a limited extent by means of ether or a solution of soap in water, naphtha, benzol, hot solutions in water of potassium or sodium hydroxide (caustic potash or soda).

25.—*Printing Pads, To Remove Aniline Ink from.*—Saturate a sponge in water as hot as possible to bear the hand in, pass the wet sponge across the face of the pad, and the ink will disappear. Then rinse off the face with the sponge, dipped in cold water. Experience has also taught that when the print begins to get dim, if you will dampen the face of the pad with a sponge dipped in cold water, the ink becomes as bright as at first, and in this way a much larger number of letters may be pulled than if this process is not employed.

26.—*Red Ink.*—a.—Stains of red aniline ink may be removed by moistening the spot with strong alcohol acidulated with nitric acid. Unless the stain is produced by eosine, it disappears without difficulty. Paper is hardly affected by the process; still, it is always advisable to make a blank experiment first.

b.—Make a solution of 7 parts of sodium nitrate and 15 parts of dilute sulphuric acid in 500 parts of water; apply to the spot of writing to be erased with a camel's-hair brush, and rinse carefully.

29.—*Wood.*—a.—Mix 1 lb. of sulphuric acid and 2 qt. of water. Apply to the stain after scouring with sand.

b.—Put a few drops of spirits of niter (nitric acid) in a teaspoonful of water, touch the spot with a feather dipped in the mixture, and, on the ink disappearing, rub immediately with a rag wetted in cold water, or it will leave a white mark. It should then be polished.

Instruments.

1.—*Brass.*—a.—If the instruments are very much oxidized, or covered with green rust, first wash them with strong soda and water. If not so very bad, this first process may be dispensed with. Then apply a mixture of 1 part of common sulphuric acid and 12 parts of water, mixed in an earthen vessel, and afterward polish with oil and rotten stone, well scouring with oil and rotten stone, and using a piece of soft leather and a little dry rotten stone to give a brilliant polish. In future cleaning, oil and rotten stone will be found sufficient.

b.—Take a strip of coarse linen, saturate with oil and powdered rotten stone, put around the tubing of instrument, and work backward and forward; polish with dry rotten stone. Do not use acid of any kind, as it is injurious to the joints. To hold the instrument, get a piece of wood turned to insert in the bells; fix in a bench vise. The piece of wood will also serve for taking out any dents you may get in the bells.

c.—Oil and rotten stone for this purpose, though very efficacious, are objectionable on account of dirt, the oil finding its way to the pistons, and because the instrument cleaned in this manner so soon tarnishes. Dissolve some common soda in warm water, shred into it some scraps of yellow soap, and boil it till the soap it all melted. Then take it from the fire, and when it is cool add a little turpentine and sufficient rotten stone to make a stiff paste. Keep it in a tin box, covered from the air, and if it gets hard, moisten a small quantity with water for use.

2. *Drawing Instruments.*—If the lacquering is badly spotted, clean it off with strong alcohol, and then polish the brass or German silver with the following paste by means of flannel and a little water, and polish off with clean chamois leather or cotton cloth and a little whiting, after which you might revarnish with shellac dissolved in alcohol, colored with a little dragon's blood, which can be got from any apothecary: Soft soap, 3 oz.; sweet oil, ½ oz.; turpentine, ¼ oz.; powdered rotten stone, 4 oz.; finest flour emery, 1 oz.; fine powdered crocus of antimony, ½ oz. Melt the soap, oil and turpentine together, add the powders, a little water to make a stiff paste, and mix well.

3.—*Rust.*—a.—The following receipt is highly recommended by *Kraft und Licht:* Lay the instruments overnight in a saturated solution of chloride of tin. The spots of rust disappear by reduction. After their removal rinse the instruments well in clear water, and immerse them in a hot suds made with soda soap, and dry well. Though not absolutely necessary, yet it is advisable to give them another cleansing with pure alcohol and polishing powder.

b.—Another simple means for the removal of rust is common petroleum. Still another method is to grease them with paraffine oil. This is rather irksome with complicated instruments, and with needles scarcely possible to do properly and effectively. The following substitute is recommended:

c.—Make up a solution of 1 parts of paraffine oil in 200 parts of benzine. In this dip the instruments, which have become thoroughly dry by lying in warm air. Work their movable parts, if they are forceps or scissors, when immersed, to allow the fluid to penetrate every crevice. Now place them upon a tray, in a warm place, to allow the benzine to evaporate. Needles are simply thrown into the solution, allowed to remain a few minutes, the liquid drained off, and the needles left to dry by the natural volatilization of the residual benzine.

d.—Brodie gives the following as an effective method (*Jour. Brit. Dent. Assoc.*): "Fill a suitable vessel with a saturated solution of stannous chloride in distilled water. Immerse the rusty instruments, and let them remain overnight. Rub dry with chamois after rinsing in running water, and they will be of a bright silvery whiteness."

e.—If instruments are badly rusted, the best plan is to send them to a cutler or instrument make and let him regrind and polish. If only superficially attacked, the following will answer admirably: Potassium cyanide, 16 parts; levigated chalk, 30 parts; soap, shaved, 15 parts; water, sufficient. Dissolve the soap in sufficient water to make, with the chalk, a thick paste, in which incorporate the cyanide. With this paste rub the blades well until the rust disappears and a polished surface is attained. The operation is rendered more rapid if the blades or objects be soaked in kerosene overnight, and the surface rust scraped off with anything that will not scratch the blades. Do not forget the deadly nature of the scouring paste, and take proper precaution to protect the hands. Use an old stiff tooth brush in applying the paste.

f.—A medical exchange recommends first rubbing with wood ashes and soft water, then soaking in a weak solution of hydrochloric acid in water (about 10 to 15 drops to the fluid ounce) for a few hours, to remove the rust and grease; then washing well in pure soft water. The next step is to place them in a bath consisting of a saturated solution of tin chloride. Let them remain 10 to 24 hours, according to the coating desired. When removed from the bath, wash them clean in pure water, and dry well. When finished, the steel will appear as if nickel-plated.

4.—*Sterilizing Dental Instruments.*—a.—Martin (*Essentials of Surgery*) recommends the following treatment for all surgical instruments: Brush with a solution of carbolic acid (1.20); sterilize by roasting, boiling, or by storing for 1 hour in a 1-20 carbolic solution. During the operation keep in a 1-40 carbolic solution. To prevent rusting, boil in 1% solution of sodium carbonate.

b.—A very effectual method is to place the instruments in metal boxes and heat in an ordinary oven (200° F.) for ½ to 1 hour; they may then be used dry.

Iron and Steel.

1.—*Finishing and Polishing.*—We now come to the means adopted for finishing and polishing steel and iron. Take, for instance, a surface of steel as an example. The square stem of a drilling instrument will form a very good subject. After it is roughed out and the work all done, it must be draw-filed, and this must be done with a superfine file, and the lines must be kept quite straight, otherwise it will require so much emery paper that the edges will lose the sharp angles which are the beauty of the work, And ordinary workmen can rub away with emery paper, but in so doing he may spoil the appearance of a piece of good work, and that without knowing it. To avoid this, the smoother and better it is filed the less paper will it require. To get the beautiful finish we see on the best work a piece of flour emery paper, well worn, and a little oil upon it, will be found the best thing to use, and when this has been well worked, to get the high polish, a piece of wood, flat upon the surface, with some fine crocus, will bring it up to this state; and if any deep scratches be there, you will at once observe them, and to remove them, in all probability, it will have to be filed all over again. Now, to avoid all this loss of time, great care must be taken that the scratches are removed before any attempt is made to polish. Having finished the work so far, many prefer to see it left straight; others, again, like to see it in some way ornamented. Now, there are several ways of doing this. First, then, to cross the surface. This is done by folding a piece of emery paper tightly around a file, but the process is not the merely pushing it across the work and making a mark, but it requires some practice to produce a good pattern, and the wrist must take a kind of circular action; and by doing this each line becomes, so to speak, connected, and makes a much better finish than a series of lines only. Another process of finishing steel is to curl all over the surface with a piece of oil stone that will cut. This is a most difficult thing to obtain, as very few stones will cut steel to leave the bright marks necessary to give it the appearance desired. When a piece of this is once obtained it is really a prize, and if it wears away it may be inserted as far as possible into a wooden handle. To use the stone, when it is once obtained, is the next thing. This is done by holding it firmly in the hand and moving it about in all directions, like curling brass. There is no stated number or size of the curl, but this is quite a matter of taste, and must be left to the operator. Another way of finishing iron and steel is with the scraper, which is used with both hands, and the work must be scraped in various directions, but with regularity. Large surfaces are sometimes done in this way. Lathe beds at times are done so, but we think this is somewhat out of character, as the fact of continually drawing the poppit head up and down the bed produces a series of lines which looks most unsightly. Regarding all this, it is all a matter of taste, and the style of finish must be left to the operator.

2.—*Grinding.*—The method generally employed by machinists in grinding and polishing either new or old work is to mix the polishing material with oil, usually refuse machinery oil; in most cases this is a great mistake, and has caused the loss of time, patience and money. Take, for instance, the grinding to a true bearing of a stopcock, a valve seat, or a slide valve. There is few machinists but what have had more or less of that class of work to do, particularly in jobbing shops, and we seldom find one who uses the same method of accomplishing the job that is practiced in shops where that class of work is made a specialty. In fitting and grinding the plug into the barrel of a cock a little judgment and care will save a great deal of hard labor, and in no case should oil be mixed with any of the grinding material, for the following reasons: If fine emery, ground glass, or sand, is used with oil, it requires but a few turns of the plug in the barrel to break up the grains of the grinding material into very fine particles; the metallic surfaces also grind off, and the fine particles of metal, mixing in with the grinding material and oil, make a thick paste of the mass. At this stage it is impossible to grind or bring the metallic surfaces to a bearing, as the gluey paste keeps them apart; if more grinding stuff is applied it will prevent the operator from seeing what part of the barrel and plug bears the hardest. Again, if the grinding material be distributed over the whole surface, the parts that do not bear will grind off as fast as the parts that touch hard, as the particles work freely between the surfaces; should the barrel and plug bear equally all over when fitted, it requires more care than if it were a top or bottom bearing, as that part of the barrel and plug across the waterway grinds twice as fast as the other parts; therefore, it should be kept the driest. Now this objection holds good in the grinding of valve seats or slide valves, to wit: the separation of the surfaces of the metal by a thick, pasty grinding material. In order to bring the surfaces to a perfect bearing rapidly, and with little labor, the following directions will be found worth a trial: To grind a stopcock of any kind, first see that the plug fits the barrel before it is taken from the lathe. Run a half-round smooth file up and down the barrel to break any rings that may be in it; a few rubs of a smooth file back and forth over the plug will break away any rings or tool marks on it Wipe both parts clean. Use for grinding material fine molders' sand, sifted through a fine sieve Mix with water in a cup, and apply a small quantity to the parts that bear the hardest. Turn rapidly, pressing gently every few turns; if the work is large, and the lathe is used, run slowly; press and pull back rapidly to prevent sticking and ringing; apply grinding sand and water until a bearing shows on another part, then use no more new sand, but spread the old that has worked out, over the whole surface. Turn rapidly, pressing gently while turning; withdraw the plug, and wipe part of the dirt off, and rub on the place a little brown soap; moisten with water, and press the surfaces together with all the force at hand, turning at the same time. Remove the plug and wipe both parts clean; next try the condition of the bearing by pressing the dry surfaces together with great force. If the parts have been kept closely together while grinding, and the plug has not rubbed against the lower part of the barrel, the surfaces will be found bright all over and a perfect bearing obtained. If an iron barrel and a brass plug are used, or two kinds of brass, a hard and soft metal, soap should be used freely when finishing up, as the tendency to form rings is greater when two different metals are used.

In grinding a slide valve which has been in use until hollow places have worn in the surface, emery mixed with water, or sand and water, will be found better than oil, unless a light body of oil, such as kerosene, is used. If water is used with the grinding material, soap should be rubbed on hollow places, and the grinding stuff should be applied to the high parts in small quantities, keeping the low parts clean and dry until an even surface is obtained all over; then the worn-out stuff should be used for finishing up. In polishing metal, oil that will gum up should not be used with the polishing material unless for a dead fine polish.

3.—*Pickling and Cleaning.*—Castings that are to be machined require to have the scale and dross removed, and while in certain cases the sandblast is used for this purpose, the more common practice is to subject the castings to an acid "pickle."

Iron castings are usually pickled with sulphuric acid or hydrofluoric acid, the former being most commonly used. The sulphuric acid pickling solution is usually made up of 1 part of sulpruric acid to 10 parts of water. The sulphuric acid should always be poured in the water while the latter is being stirred. The reason for this is that a chemical reaction takes place which causes the bath to become quite warm; but there is no dangerous ebullition if properly mixed. But if the water is poured upon the sulphuric acid, the latter, being much heavier than water, remains at the bottom. When an attempt is made to stir the solution the water enters the acid in small streams, and is instantly raised to the boiling point, generating stream, which may cause an explosion. Such an accident would be likely to draw the concentrated acid over the workman, and result in serious burns.

Sulphuric acid will no attack the sand or black oxide of iron forming the scale upon castings, but the sand and scale are porous, and the acid soaks through and attacks the iron under the scale. It finally dissolves a sufficient amount of iron under the scale to loosen the latter. When the workman sees that the scale is all loose, the castings should be removed and washed, preferably with hot water. If the castings are small, it is a good practice, after washing, to immerse them in a soda solution for a short time in order to thoroughly neutralize any acid.

One great objection to the use of sulphuric acid as a pickling solution is that, if there are any soft or spongy spots in the iron the acid will penetrate these, and it would be practically impossible to wash it out or neutralize it in the soda bath. Any acid thus entrapped in the castings will continue to eat until it is changed to sulphate of iron or green vitriol. This will tend to make the spongy or soft spots in the iron still worse, and may weaken the castings to a large extent. If the acid has been used a number of times, a large portion of it is converted into green vitriol, and hence the solution will not attack the iron. In this case it is necessary to add more acid to the bath, or else to throw away the old bath and make up a new one.

While the workman may receive quite serious burns from sulphuric acid, it is not nearly as dangerous as hydrofluoric acid. The thin hydrofluoric acid will penetrate the skin and attack the flesh and bones underneath, and may result in very serious injuries. It will also attack the fingernails very readily; but if used with care, it makes a pickling solution which has a number of advantages over sulphuric acid.

Hydrofluoric acid is commonly sold in three grades. The first contains 30% of acid, the second 48%, and the third 52%, the balance of the solution being water. The 30% solution is that usually employed for pickling castings. One gallon of the 30% solution should be used to 20 to 25 gal. of water. If it is desired to pickle more rapidly, less water may be used; and if it is desired to get more use of the acid—that is, make it do more work—slightly more water may be used. Hydrofluoric acid does not act upon the iron to an appreciable extent, but attacks the sand and dissolves it. It also dissolves the black oxide of iron.

When castings are pickled in sulphuric acid the surface is left with a dull or black appearance. When pickled in hydrofluoric acid the surface has a much whiter and often almost silvery appearance. The surface of castings pickled with hydrofluoric acid is also very much smoother than those pickled with sulphuric acid. For this reason, hydrofluoric-acid pickling is used in almost all cases in which the parts are to be polished or nickelplated, and sulphuric-acid pickling only in cases where it is desired to remove the scale so as to facilitate the machining of the castings.

When pickling with hydrofluoric acid the small castings may be put into the bath and the larger ones may have the acid poured over them, just as if working with sulphuric acid. The hydrofluoric-acid bath is always used cold but should be kept above the freezing point. The bath can be used repeatedly by adding about one-third the original quantity of acid before introducing a new lot of castings. If it is desired to keep the surface of the castings bright after they are pickled in hydrofluoric acid, they should be washed with hot water immediately after coming out of the acid, and should be left in the water until they are heated through. If this is done when the castings are taken out of the water they will dry quickly from the heat which they have absorbed from the water. If the castings are washed in cold water they will remain wet of some time, and hence will rust. A little lime is frequently added to the washing water which is used after hydrofluoric-acid pickling.

When handling concentrated hydrofluoric acid, the workman should always use rubber gloves. If any acid is dropped or splashed on the skin it should be washed off at once with water and dilute ammonia, and this will usually prevent any injury. The dilute hydrofluoric acid of the pickle bath will not attack the skin instantly, but the workman should never put his hands into this solution, as it will attack the hands to some extent, and will result in serious sores if he persists in handling the castings when wet with the pickling solution. The dilute sulphuric-acid pickling solution will not injure the hands if it is spilled upon them; in fact, its only effect is to make the skin coarse and rough.

4.—*Polishing and Protecting.*—a.—Usually, the article to be polished is first rubbed down with emery of gradually increasing fineness, after which the article is moistened with alcohol or water, and polished with Vienna lime, rouge or tin putty.

b.—Use tin putty and hartshorn, triturated in alcohol. Use with any soft leather. This is an excellent polish.

c.—Take an ordinary bar of malleable iron, in its usual merchantable state, remove the oxide from its surface by the application of diluted sulphuric acid, after which wash the bar in an alkaline solution, then cover the entire bar with oil or petroleum. The bar is then ready for the chief process. A muffle surface is so prepared that a uniform, or nearly uniform, heat can be maintained within it, and in this furnace the bar is placed. Care must be taken that too great a heat is not imparted to it, for on this depends the success of the operation. When the bar approaches a red heat, and when the redness is just perceptible, it is a certain indication that the proper degree has been attained. The bar is then at once removed and passed through the finishing rolls 5 or 6 times, when it will be found to have a dark, polished, uniform surface and the appearance of Russian sheet iron.

d.—Take a spongy piece of fig-tree wood and well saturate it with a mixture of sweet oil and finely powdered emery, and with this well rub all the rusty parts. This will not only clean the article, but will at the same time polish it, and so render the use of whiting unnecessary.

e.—Bright iron or steel goods (as polished grates and fire irons) may be preserved from rust in the following manner: Having first been thoroughly cleaned, they should be dusted over with powdered quicklime and thus left until wanted for use. Coils of piano wire are covered in this manner, and will keep free from rust for many years.

f.—Dissolve ½ oz. of camphor and 1 lb. of hog's lard, and take off the scum; then mix with the lard as much black lead as will give the mixture an iron color. Rub the articles all over with this mixture and let them lie for 24 hours; then dry with a linen cloth, and they will keep clean for months.

g.—Table knives which are not in constant use should be put in a case containing a depth of about 8 in of quicklime. They are to be plunged into this to the top of the blades, but the lime must not touch the handles.

h—Steel bits that are tarnished, but not rusty, can be cleaned with rotten stone, common hard soap and a woolen cloth.

i.—Finished Surfaces.—Oil is usually employed for polishing delicate instruments, which tends to soil those using them. Oil may be advantageously replaced by a mixture of 3 parts of glycerine and 1 part of alcohol for large surfaces. When small ones are to be treated, pure glycerine can be used.

5.—*Iron.*—a.—You cannot keep the bright color of polished iron on the hot parts of an engine without constant attention and wiping with engine oil. Oxalic acid may help the cleaning, but the acid left on the bright surface favors oxidation. For cleaning, use tripoli, rotten stone or pulverized pumice stone, with engine or kerosene oil. Neglected or dirty spots may be removed with a scroper and fine emery paper, and afterward rubbed with oil. Every part of bright work around an engine should be wiped with oil. Moisture immediately discolors a clean, bright surface. Polish the lubricator with rotten stone and oil only, and only when necessary. Too much polishing soon makes it look cold from wear.

b.—Bright Polish Like Steel.—Blue vitriol, 1½ oz.; borax, 1½ oz.; prussiate of potash, 1½ oz.; charcoal, 1½ oz.; salt, ¾ pt. Pulverize, and dissolve in 1½ qt of hot water; add 1½ gal. of linseed oil; mix well. Bring the iron or steel to the proper heat, and cool in this solution

c.—Brilliant Luster, To Give.—Pulverized arsenious acid, 7½ dr.; elutriated bloodstone, 7½ oz.; antimony trichloride (butter of antimony), 3¾ oz. Pour over these materials 5 pt. of 90% alcohol. Digest at a gentle heat, shaking frequently. When iron is polished with this fluid it precipitates upon it a thin film of antimony and arsenic, which protects the iron from oxidation, and also gives it a fine appearance.

d—Cement Wash for the Protection of Ironwork.—According to *La Revue Technique*, coatings or coverings of cement have been employed by certain railway companies in France for some years past to protect the metallic portions of bridges crossing their lines from the rapid destruction to which such parts are liable by reason of oxidation, through being continually exposed to the action of clouds of steam and gas, products of combustion escaping from the locomotives. Formerly the practice was to protect structures that were most exposed to deterioration by providing sheet-metal guards, in the form of reversed channels, secured to beams in a direction parallel to the lines At present, a coating of cement is used. To apply the cement, brush down the ironwork with a heather broom dampened with a rag or whitewash brush, and afterward apply two coats of Portland-cement wash, made rather thick, to which has been added a proportion of fine sharp sand. In Berlin, a coating of mortar containing one-third part of cement has likewise been successfully employed for preserving the parts of ironwork which are buried in the ground.

e.—Keys, Keyrings, and Other Articles of Iron.—Finish them well with a dead smooth file, then mix some fine emery and oil together, hold the key in wood clamps, take some long strips of wash leather, dip in the above, and polish well every part until all scars disappear; then tie 2 or 3 doz. on a piece of iron binding wire, put them in an iron box with leather scraps burnt and made into a fine powder, cover bottom of box ½ in. thick, spread out the keys on this, cover them up with the powder or leather dust, put a lid on, tie down, put in a slow fire until the box is red hot, soak about 20 minutes, then open the box, take out the keys quick, plunge them in oil—water makes them too brittle; now repeat the polishing as before, with long leather strings dipped in the oil and emery, until all the black from the hardening is off every part; then take them to the brushing frame, charge your brush well with flour of emery, keep turning the key in every direction until the polish begins to appear; after this dip them in slaked lime, and get off every particle of grease. Take them to another brushing frame, the brush charged with crocus and water; keep dipping the key in occasionally, and follow up process on the brush until the polish comes up well. To put the extra gloss or polish on, take the leather strings, as before, this time dipped in a mixture of putty powder and water; work the string well over every part until a dark polish comes up. If you wish a higher polish, it is done by hand; that is, girls dip their hands in the putty powder mixture above, and rub every possible part up with the palm of the hand, and this gives the beautiful polish that is upon them.

f.—Plates, Wire, etc.—Boden recommends the following method of brightening the surfaces of iron plates, wire, etc., as the result of numeroous experiments made in the laboratory of the Industrial Museum at Munich: The object, whatever it may be, just as it comes from the forge, is laid for the space of 1 hour in dilute sulphuric acid (1-20 part acid). The action of the acid may be increased by the addition of a little carbolic acid(?). The forge scales are loosened by the action of the acid, and the object is then washed clean with water and dried with sawdust. Next, it is held for an instant in nitrous acid, the operator, of course, being on his guard against the nitrous fumes, washed again carefully, dried in sawdust, and rubbed over clean. Iron goods thus treated acquire a perfectly bright, pure surface, having a white glance, without the intervention of any mechanical process of polishing.

g.—Pots, Iron.—Put a few ounces of washing soda (sodium carbonate) into the pot, fill with water, and boil until the inside looks clean.

h.—Scale from Iron Caused by Heat.—Use by volume, sulphuric acid, 1 part; nitric acid, 1 part; water, 2 parts; applied warm. Either the acid or the iron may be heated.

i.—Wrought Iron, To Polish.—Warm goods till they are unbearable to the hand, then rub with new, clean, white wax. Heat the goods again so that the wax may spread on them; then rub them over with a piece of serge.

6.—*Machinery, Tools, etc.*—a.—Two or three cents' worth of paraffine, chipped fine, are added to 1 l. of petroleum in a stoppered bottle, and during 2 or 3 days, from time to time, shaken up until the paraffine is dissolved. To apply it, the mixture is well shaken, spread upon the metal to be cleaned, by means of a woolen rag or brush, and on the following day rubbed off with a dry woolen rag.

b.—In a corked bottle, mix 20 parts of petroleum with 1 part of paraffine; apply the mixture by means of a rag or brush, and rub well the next morning with dry wool.

c.—Oil of turpentine, 5 parts; stearine, 25 parts; polishing red, 25 parts; animal charcoal, 25 parts; stir into spirit, and shake well until a homogeneous liquid mass has been obtained. This is applied with a brush, and the spirit allowed to evaporate. The surface is then rubbed with a mixture of 25 parts of red and 45 parts of animal charcoal.

d.—The chemical laboratory of the Industrial Museum of Batavia recommends a mixture of oil of turpentine, 15 parts; oil of stearine, 25 parts; jewelers' red, 25 parts; animal charcoal, of superior quality, 45 parts. Alcohol is added to this mixture in such quantity as to render it almost liquid, then by means of a brush it is put on those parts that are to be polished. When the alcohol has dried, the remaining cover is rubbed with a mixture of 45 parts of animal charcoal and 25 parts of jewelers' red. The rubbed parts will become quite clean and bright.

e.—Levigated rotten stone, 1 part; iron subcarbonate, 3 parts; oil of bitter almonds, to perfume; olive oil, to make a paste.

f.—Oxalic acid, 1 part; jewelers' rouge, 15 parts; powdered rotten stone, 20 parts; palm oil, 60 parts; petrolatum, 4 parts.

g.—The following paste is recommended for polishing machinery and iron or steel ware: Oil of turpentine, 5 parts; paraffine, 25 parts; finest emery, 25 parts; fine powdered animal charcoal, 45 parts; The paste thus formed is thinned down with methylated spirit, then applied to the parts to be cleaned with a brush. When the spirit evaporates, the surface is well polished.

h.—Friction Polish.—A good polish for iron or steel rotating in the lathe is made by using fine emery and oil, which is applied by lead or wood clamps, screwed together. Three very good oils for lubrication are olive oil, sperm and neatsfoot.

7.—*Steel.*—Glaze Wheels for Finishing.—For hollow finishing, the following wheels are required: A mahogany wheel for rough glazing, a mahogany wheel for smooth glazing; a lead wheel, or lap. For flat finishing: A buff wheel for rough, a buff wheel for smooth, a buff wheel for finishing. Lastly, a polisher. To make the glaze wheels: Get the spindles, and point them on each end; then get a block of beech, and wedge it on the steel at one end with iron wedges, and turn it for the pulley for the band to run on. Take two pieces of flat mahogany, and glue and screw them together, so that the grain of one piece cross the other, to prevent warping. Let it get thoroughly dry, and wedge it on the spindle and turn it true. The lead wheel is made the same way, but wider, and has a groove turned in the edge. The wheel is put into sand, and a ring of lead run around the edge; it is then turned true. To make the buff wheels, proceed as with the glaze, but to save expense, pine or deal wood will do as well as mahogany, only leave it about double the width of the glaze, which is about ½ in. wide by 12 or 14 in. across. The buff wheels are covered with glue, and then the leather is tacked on with tacks driven in about half way, so that they may be easily drawn out again. The leather is then turned true. The polisher is made the same way, but the size of the polisher mus be a little less than any of the other wheels, say about 1 in. The buff wheels are dressed by laying on a fine thin coat of clear glue, and rolling them around—No. 1 in superfine corn emery, No. 2 in smooth emery, No. 3 by making a cake of equal parts of mutton suet, beeswax and washed emery; then it is held on the wheel while it is going around. The glaze wheels are dressed while using, by mixing a little of the emery with oil, and putting it on the wheel with a stick or the finger. The leather of the polisher is not covered with glue, but dressed with a mixture of crocus and water, not oil. Care must be taken to keep each wheel and substance to themselves; the work must be carefully wiped after each operation, and cleanliness must be studied above all things in using the polisher, as the slightest grease getting on it stops the polishing.

a.—Polishing.—(1) Use bell-metal polishers for arbors, having first brought up the surface with oilstone dust and oil and soft steel polishers; for flat pieces, use a piece of glass for the oilstone dust, a bell-metal block for the sharp red stuff, and a white metal block for the fine red stuff. The polishing stuff must be well mixed up, and kept very clean; the polishers and blocks must be filed to clean off the old stuff, and then rubbed over with soft bread; put only a little red stuff on the block, and keep working it until it is quite dry; the piece will then leave the block quite clean; use bread to clean off the surplus red stuff before using the brush. If the piece is scratched, put on some more red stuff, which must not be too wet, and try again.

(2) The polish on flat steel pieces in fine watchwork is produced with oilstone dust, burnt Turkey stone, and a steel polisher, soft steel, bell metal, and sharp stuff, grain tin and glossing stuff. The metals are squared with a file, and vary in shape according to the work in hand.

(3) Get an 18-gal. barrel and put an iron spindle through the two ends; mount it on trestles in the same way as a butter churn, with a winch to turn it by; cut a hole in the side by which to introduce the articles to be polished; have a tight-fitting cover to the hole; procure some worn-out casting pots or crucibles, such as used by founders, and pound them in an iron mortar until fine enough to pass through a sieve which will not allow the steel articles to pass through. Put equal quantities of this grit, and of the articles, in the barrel; fasten on the cover and turn the barrel for about an hour at the rate of about 50 turns a minute; take all out of the barrel and sift out the grit. If a finer polish than this is required, put them through another turning, substituting for the grit small scraps of leather, called mosings, which can be procured from curriers, and emery flour. Do not more than half fill the barrel.

(4) Wet Vienna lime to a paste. Apply to buff, and finish dry.

(5) Arsenious acid, 1½ dr.; elutriated bloodstone, 1½ dr.; antimony trichloride, 6 fl.dr.; 90% alcohol, 1 pt. Digest at a gentle heat, shaking frequently.

(6) Cutlery.—The burnishing of cutlery is executed by hand or vise burnishers; they are all made of fine steel, hardened, and well polished. The first kind have nothing particular in their construction; but vise burnishers are formed and mounted in a very different manner. On a long piece of wood, placed horizontally in the vise, is fixed another piece, as long, but bent in the form of a bow, the concavity of which is turned downward.

These two pieces are united at one end of their extremities by a pin and a hook, which allows the upper piece to move freely around this point as a center. The burnisher is fixed in the middle of this bent piece, and it is made more or less projecting, by the greater or lesser length which is given to its base. The movable piece of woood, at the extremity opposite the hook, is furnished with a handle, which serves the workman as a lever. This position allows the burnisher to rest with greater force against the article to be burnished, which is placed on the fixed piece of wood. The burnisher has either the form of the face of a round-headed hammer, well polished to burnish those pieces which are plain or convex, or the form of two cones opposed at their summits, with their bases rounded, to burnish those pieces which are concave or ring-shaped.

(7) Dress Swords, etc., Varnish for.—Gum sandarac, by weight, 15 parts; small mastic, by weight, 10 parts; elemi, by weight, 5 parts; camphor, by weight, 3 parts. Dissolve the whole over the water bath in sufficient alcohol for the purpose. This varnish is used cold. It preserves the blade from rust, and is transparent.

Ivory, Horn, Bones, Cleaning and Bleaching.

Bones.—Dip the bones for a few minutes in a boiling solution of 1 lb. of caustic soda in 1 gal. of water; then rinse them thoroughly in water, rubbing them down with fine pumice stone, and expose them until whitened with the vapor of burning sulphur largely diluted with air, finally rinsing in warm water. Bones may also be whitened by exposure in a weak solution of Javelle water.

Horn.—Besides hydrogen peroxide, horns can be bleached by immersing for a short time in water slightly mixed with sulphuric acid, chloride of lime, or chlorine, or they may be exposed in the moist state to the fumes of burning sulphur, largely diluted with air.

Ivory.—The *Pharmaceutische Zeitung* recommends the first four methods.

1.—Expose the ivory for 3 or 4 days to the action of sunlight, in a bath of turpentine oil.

2.—Treat it alternately with a solution of potassium permanganate (1 : 250) and oxalic acid (1 : 100), letting the ivory remain in each solution for a half hour; then rinse well with water, and repeat the process a number of times.

3.—Place the ivory in a hot mixture of unslaked lime, bran and water; remove after a very short interval, place in dry sawdust, and with the latter rub thoroughly; then expose to the air.

4.—Place in very dilute sulphuric acid or in a solution of lime chloride, then wash off; this is claimed to restore the white color.

5.—To whiten old ivory, wipe it with flannel which has been wetted with essence of turpentine, then expose for several days to the sun.

6.—First clean the ivory by boiling it with a paste composed of burned pumice stone and water. After cleansing, place the article under a glass vessel and expose it to the sun's days until it assumes its original whiteness. The ivory should be kept moist with water while bleaching. If the first operation does not succeed perfectly, it should be repeated.

7.—Mix a thin lime paste and heat over a moderate fire. Place the ivory in this paste, and leave it until it bleaches white, after which remove the paste, dry, and polish.

8.—Dr. Artus's Process.—The ivory articles are placed in a solution containing 11½ oz. of carbonate of soda, in crystals, and 45⅝ oz. of water, and allowed to remain in the solution for 2 days. The articles are then removed from the solution, well washed in pure water, and then smeared for 5 or 6 days in a solution composed of 17 oz. of sulphite of soda and 45½ oz. of water. At the end of 5 or 6 days there should be added to the solution containing the articles 1 oz. of hydrochloric acid diluted with 5½ oz. of water. The vessel containing the liquid should then be covered, and left standing for from 24 to 26 hours, after which the ivory may be taken out, washed in clean water, and dried. The quantities named in this book are sufficient to bleach 22½ ounces of ivory. A glass or porcelain vessel should be used, as the acid will act upon metallic vessels. A very fine polish may be put upon the ivory by the use of putty powder and water, applied by means of a rubber made of an old felt hat. If the ivory articles are of a character to be placed in a lathe, they may be polished by the use of pulverized pumice stone mixed with water, after which the ivory should be heated by rubbing it, while revolving in the lathe, with a piece of linen or sheepskin, and when it has become hot it should then be rubbed with a little whiting mixed with olive oil, then with a little dry whiting, and finally with a piece of soft white rag.

9.—Immerse for a short time in water

slightly mixed with sulphuric acid, chloride of lime, or chlorine, or it may be exposed in the moist state to the fumes of burning sulphur, largely diluted with air. Ink stains may be removed by repeatedly using a solution of caustic potash in water.

10.—Ivory that has become yellow by exposure can be whitened by washing in a solution composed of 1 oz. of nitric acid and 10 oz. of soft water; apply with a rough brush; cleanse thoroughly with clean water.

11.—Peroxide of hydrogen is used in Sheffield to bleach the inferior ivory for knife handles. The mode of procedure is as follows: Place, say, 2 qt. of the liquid in a stone pot, adding 4 oz. of liquid ammonia fort (880°), immerse the handles, and put over a common shop stove for 24 to 36 hours; the handles are then taken out and gradually dried in the air, not too quickly, or they would split. The deep color of the ivory is removed, and a beautiful pearly white ivory results when polished. The ivory is previously treated with a solution of common soda to get rid of greasy matter and open the pores.

12.—Antique works in ivory that have become discolored may be brought to a pure whiteness by exposing them to the sun under glasses. It is the particular property of ivory to resist the action of the sun's rays when it is under glass; but when deprived of this protection to become covered with a multitude of minute cracks. Many antique pieces of sculpture in ivory may be seen, which, although tolerably white, are, at the same time, defaced by numerous cracks. This defect cannot be remedied; but in order to conceal it the dust may be removed by brushing the work with warm water and soap, and afterward placing it under glass. Antique works in ivory that have become discolored may be brushed with pumice stone, calcined and diluted, and, while yet wet, placed under glasses. They should be daily exposed to the action of the sun, and be turned from time to time, that they may become equally bleached; if the brown color be deeper on one side than the other, that side will, of course, be for the longest time exposed to the sun.

13.—To bleach ivory, place the ivory in a saturated solution of alum for an hour. Polish with a woolen cloth, and wrap in linen to dry. Also with peroxide of hydrogen, to 1 pt. add 1 oz. of aqua ammonia. Warm, soak the ivory for 24 hours, wipe, and polish with chalk.

14.—Peineman's Process of Bleaching Ivory which Has Turned Yellow.—Place the ivory in a saturated solution of alum, soak for 1 hour; rub with a woolen cloth, and wrap in a linen cloth to dry. Another method which is preferred by some is to prepare a thin paste with lime, heat over a fire; put the ivory in this paste and let it remain until it becomes white; take out, dry and polish.

15.—To bleach ivory handles of steel tools, protect the steel with a coat of wax or paraffine, and set the handles in a solution of chloride of lime, 1 part, to 4 parts of water, for a day, more or less, then wash the handles with clean warm water, wipe and dry. If satisfactory, warm the metal part and wipe off the wax or paraffine. Another way is to dip the handles in a saturated solution of alum in water for from 1 to 3 hours, wash, wipe and dry. If the handles are not very dark, the latter way is preferable. For polishing the steel points, use putty powder (oxide of tin) on a buff wheel wet with alcohol. This will not stain the handles.

16.—Piano Key, Bleaching.—The reason piano keys turn yellow is because they absorb the grease from the fingers; it will, therefore, be necessary to remove this. If a paste made from whiting and a solution of potash is laid on, and allowed to remain for about 24 hours, the ivories will be restored very nearly, if not quite, to their original color without removing them from the keys.

17. Smoke Stains.—Immense in benzine; if burned, there is no remedy.

Jet.

Remove all dust with a very soft brush, touch the jet with a bit of cotton moistened with a little good oil; polish with wash leather. Clean with great care, as the jet is often brittle.

Jewelry.

1.—Common jewelry may be effectually cleaned by washing with soap and warm water, rinsing in cold water, dipping in spirits of any kind, and drying in warm boxwood sawdust. Good jewelry only needs washing with soap and water and polishing with rouge and a chamois leather.

2.—*Polishing Bar.*—Refined town tallow, 80 lb.; sesquioxide of iron, 16 lb.; oxalic acid, 1 lb. Powder the acid, mix with sesquioxide, and mold with the tallow into bars, like soap. The sesquioxide must be quite free from grit, or it may scratch valuable work. It may be prepared by calcining equal amounts of oxalic acid and iron sulphate in a crucible for about 15 minutes with a good draught.

3.—*To Restore the Luster.*—Take 1 oz. of cyanide of potassium and dissolve it in 3 gills of water. Attach the article to be cleansed to a wire hook, immerse, and shake in the solution for a second or two, and remove, and wash in clean water, then in warm water and soap. Rinse again, dip in alcohol, and dry in boxwood sawdust. If the solution is kept, put it in a tightly corked bottle, and label poison conspicuously. One caution is necessary: Do not bend over the solution so as to inhale the odor, nor dip the fingers in it; if one of the articles drops from the hook, better empty the solution into another vessel.

Knives, To Remove Stains.

Cut a solid potato in two, dip one of the pieces in brick dust, such as is usually used for knife cleaning, and rub the blade with it.

Lace.

1.—*Black, To Revive.*—a.—Make some black tea, about the strength usual for drinking, and strain it off the leaves. Pour enough tea into a basin to cover the quantity of lace, let it stand 10 or 12 hours, then squeeze it several times, but do not rub it. Dip it frequently into the tea, which will at length assume a dirty appearance. Have ready some weak gum water, and press the lace gently through it; then clap it for a quarter of an hour, after which pin it to a towel in any shape which you wish it to take. When nearly dry, cover it with another towel and iron it with a cool iron. The lace, if previously sound, and discolored only, will, after this process, look as good as new.

b.—Wash the lace thoroughly in some good beer; use no gum water; clap the lace well, and proceed with ironing and drying, as in the former recipe.

2.—*Gold and Silver.*—a.—Sew the lace in a clean linen cloth, boil it in 1 qt. of soft water and ¼ lb. of soap, and wash it in cold water. If tarnished, apply a little warm alcohol to the tarnished spots.

b.—A weak solution of cyanide of poassium cleans gold lace well.

c.—To Remove Mildew.—For this purpose, no alkaline liquors are to be used; for while they clean the gold, they corrode the silk, and change or discharge its color. Soap also alters the shade, and even the species, of certain colors. But alcohol may be used without any danger of its injuring either color or quality, and in many cases proves as effectual for restoring the luster of the gold as the corrosive detergents. But though the alcohol is the most innocent material employed for this purpose, it is not in all cases proper. The golden covering may be in some places worn off, or the base metal with which it has been alloyed may be corroded by the air, so as to have the particles of gold disunited, while the silver underneath, tranished to a yellow hue, may continue of a tolerable color; so it is apparent that the removal of the tarnish would be prejudicial, and make the lace less like gold than it was before.

d.—To Wash.—It is placed overnight in urine, or wine, and washed. Take 1½ pt. of water and 1½ pt. of whisky, and a little ground gum arabic and saffron. Apply with a brush when the laces are stretched on a table.

Leather.

1.—Mix well together 1 lb. of French yellow ocher and 1 dessertspoonful of sweet oil; then take 1 lb. of pipeclay and ¼ lb. of starch. Mix with boiling water; when cold, lay on the leather; when dry, rub and brush well.

2.—*Belts.*—a.—If the belting is not brittle or rotten, a thorough wiping off of the excess of oil, and scraping the face with a sharp tool to take off the gummy matter, and finally wiping the inside with a little naphtha or gasoline upon a cloth, will generally restore the belt. The pulley should be cleaned also. If the belting has become weak and rotten it should be thrown away.

b.—Belts dirty from drop oil and dust may be cleaned as follows: First wash the belts with warm water and soap, using a sharp, stiff brush; and while still moist rub them with a solution of sal ammoniac, which saponifies the oil in them. Immediately thereafter the belts must be rinsed well with lukewarm water and then dried, with sufficient tension. While they are still moist the belts are to be rubbed well on the inside, and less on the outside, with the following unguent: 1 kgm. (2 lb. ¾ oz.) of India-rubber, heated to 122° F., and mixed with 1 kgm. of rectified turpentine oil. After the solution is complete, 780 grams (27 oz.) of bright rosin are added, and when it is dissolved, 750 grams (26½ oz.) of yellow wax are added. This mixture, by diligent stirring, is mixed with 3 kgm. (6 lb. 10 oz.) of fish oil and 1¼ kgm. (2 lb. 12 oz.) of tallow, previously dissolved in the former. In the further treatment of the belt, rub the inside only and the outside only the first time as stated. This unguent also replaces the tannin extracted from the leather, prevents the dragging of the belt, and imparts elasticity to it.

3.—*Belts, Military.*—First brush the belt over with a mixture of linseed oil, 4 oz.; precipitated oxide of zinc, 1 oz.; dry over a stove at a heat not over 160° F. When thoroughly dry, roughen by means of pumice powder, and apply another coating. Dry as before, and varnish with amber or copal varnish.

4.—*Carriage Tops.*—Carriage tops that have faded and become gray can be restored by washing with a solution composed of 4 oz. of nutgalls, 1 oz. each of logwood, copperas, clean iron filings and sumach berries; put all but the iron filings and copperas in 1 qt. of the best white-wine vinegar, and heat nearly to the boiling point; then add the copperas and iron filings; let them stand for 24 hours, and strain off the liquid; apply with a sponge. This is equally good for restoring black cloths.

5.—*Enameled Leather* tops that have been soiled by dust and rain should be washed with soft water and Castile or crown soap. Apply the water with a sponge, and then scrub with a moderately stiff brush; cleanse with clean water, and dry with chamois. Never apply any kind of oil or top dressing without first cleaning the leather.

6.—*Moldy Leather.*—To clean moldy leather, remove the surface mold with a dry cloth, and with another cloth apply pyroligneous acid.

7.—*Russet Leather-Covered Mountings.*—Remove all stains and dirt by rubbing the leather with a cloth and a little oxalic acid, and restore the color and finish by the use of salts of lemon, applied with a woolen cloth. Rub the leather until a good polish is produced.

8.—*Rubber-Covered Mountings.*—Rub the covered, as well as the metallic parts, with a chamois and a little tripoli, and finish with a clean woolen cloth.

9.—*Morocco Leather.*—Stain well over a board, and scour with a stiff brush, using tepid water and soft soap, made slightly acid with oxalic acid; when done, unstrain the leather, and dry in a cool place. Do not saturate the leather, but keep the board inclined; when dry, rub a little oil lightly over the surface with a rag.

10.—*Oil Spots.*—a.—To remove oil stains from leather, dab the spot carefully with spirits of sal ammoniac, and after allowing it to act for a while wash with clean water. This treatment may have to be repeated a few times, taking care, however, not to injure the color of the leather.

b.—Sometimes the spot may be removed very simply, by spreading the place rather thickly with butter, letting this act for a few hours. Next scrape off the butter with the point of a knife and rinse the stain with soap and lukewarm water.

11.—*Polish for Leather Cases.*—Eggs, 5 only; sperm oil, 6 dr.; acetic acid, 6½ dr.; glycerine, 6 dr.; oil of turpentine, 1 oz.; alcohol, 5 oz.; water, enough to make 30 oz. Mix the oils, the acid and the glycerine, and add the mixture gradually, beating continuously, to the eggs, previously beaten light. Transfer to a suitable bottle; dilute the alcohol with an equal volume of water, and add in small portions to the mixture, shaking after each addition. Lastly, add enough water to make 30 oz., and shake well.

12.—*Riding Saddles.*—a.—If much soiled, wash the leather with a weak solution of oxalic acid and water, and when dry, with the watery portion of beef blood. The latter can be preserved by adding a little carbolic acid and keeping it in a bottle, tightly corked.

b.—Brown saddles may be cleaned to look as well as new by the use of tepid water and crown soap; if the latter cannot be had, use pure Castile soap.

Leaves, To Bleach.

Mix 1 dr. of chloride of lime with 1 pt. of water, and add sufficient acetic acid to liberate the chlorine. Steep the leaves about 10 minutes, and until they are whitened; remove them on a piece of paper and wash in clean water.

Lenses.

1.—If in either objective or eyepiece the lenses are not clean, the definition may be seriously reduced or destroyed. Finger marks upon the front lens of objective, or upon eyepiece lenses, dust which in time may settle upon rear lens of objective or on eye lens, film which forms upon one or the other lens, due occasionally to the fact that glass is hygroscopic, but generally to the exhalation from the interior finish of the mountings, and, finally, in immersion objectives, because the front lens is not properly cleaned, or oil has leaked on to its rear surface, or air bubbles have formed in the oil between the cover glass and front lens. The latter two causes may totally destroy all definition, on matter how excellent the objective is or may have been.

a.—Remedy.—Keep all lenses scrupulously clean. For cleaning, use well washed linen (an old handkerchief) or Japanese lens paper.

b.—Eyepieces.—To find impurities, revolve the eyepieces during the observation; breath upon the lenses, and wipe gently, with a circular motion, and blow off any particles which may adhere.

c.—Dry Objectives.—Clean front of lens as above. To examine rear and interior lenses, use a 2-in. magnifier, looking through the rear. Remove dust from rear lens with a camel's-hair brush.

d.—Oil Immersion Objectives.—Invariably clean front lens, after use, with moistened linen or paper, and wipe dry.

e.—In applying oil, examine the front of objective with a magnifier, and if there are any air bubbles remove with a pointed quill, or remove oil entirely and apply a fresh quantity.

2.—Linen, especially, has the property of removing dirt and grease from glass, but it is difficult to clean close up to the mount with a cloth, and for this purpose pith is most suitable. The best varieties of pith are obtained from rushes, the sunflower or the elder tree. For cleaning large lenses, circular pieces of pith are glued side by side on a piece of cork, and this species of brush is passed over the surface of the lens without too much pressure. Avoid the use of polishing powder; if the dirt cannot be removed by rubbing, liquids must not be used which are liable to attack the glass. Even water has some effect, as is well known, and should be used sparingly. Among liquids admissible for the removal of grease are mentioned alcohol, ether, and oil of turpentine. The latter is regarded as distinctly objectionable from its well-known disintegrating action on glass. Manifestly, from the risks well known to opticians, which are here pointed out, a prime element in the care of lenses is to guard them as fully as practicable from becoming dirty. This is more especially important in the case of microscopic objectives. The lenses should never be touched with the fingers, the objective should be put away in its case when not in use, and stray particles of dust which may fall on the back lens removed by lightly brushing with a camel's-hair brush, which brush should be kept in a close box so as to accumulate no supply of dust itself. Japanese paper is probably the best material with which to remove fluids from immersion lenses.

3.—*Rust, To Remove.*—A lens sometimes acquires a brown, rusty stain on the surface, which no amount of rubbing or cleaning will remove. By applying a paste composed of putty powder, or very fine rouge, and water, to the stains, and then rubbing briskly with either the point of the finger or the side of the hand, every spot of rust or stain will be removed in a few minutes. This applies to photographic or other lenses, except the object glass of a telescope, which would be irreparably damaged by such treatment.

Laundry.

1.—*Bluing.*—a.—Dissolve indigo sulphate in cold water, and filter.

b.—Dissolve good cotton blue (aniline blue 6 B) in cold water.

c.—Dissolve fine Prussian or Berlin blue with ⅛ part of oxalic acid in water; or use ferrocyanide of potassium (1-12 part) in place of oxalic acid.

d.—Dissolve 7 oz. of yellow prussiate of potash in 2.1 pt. of water. Make a solution of sesquichloride of iron which shall contain 1 part of the solid salt by weight to every 10 parts of water by weight. Take equal volumes of the two solutions, and add to each twice its volume of cold concentrated solution of sulphate of soda. Finally, mix the two solutions thus obtained. The solid Prussian blue will immediately precipitate. This may be put upon a filter and washed, being kept exposed to the air for perhaps 15 or 20 days. The excess of soluble salts will first be washed away, and then the latter washings will dissolve the blue, forming a deep blue liquid, which may be used for preparations of bluing for clothing. It is, however, better to buy the soft Prussian blue than to attempt to prepare it on a small scale. One ounce of soft Prussian blue, powdered, and put into a bottle with 1 qt. of clear rain water, acidulated by ¼ oz. of oxalic acid, is a good preparation. A very small portion suffices for a large amount of clothing.

e.—Ball Blue.—The ball sold for laundry use consists usually, if not always of ultramarine. The balls are formed by compression, starch or some other excipient of like character, being added to render the mass cohesive. Blocks of blue can, of course, be made by the same process. The manufacturers of ultramarine prepare balls and cubes of the pigment on a large scale, and it does not seem likely that there would be a sufficient margin of profit to justify the making of them in a small way from the powdered pigment. Careful experiments, however, would be necessary to positively determine this. Ultramarine is of many qualities, and it may be expected that the balls will vary also in the amount of "filling" according to the price at which they are to be sold. As an illustration of the "filling" or diluting process, and a suggestion for experiment, we reprint the following: Ultramarine, 6 oz.; sodium carbonate, 4 oz.; glucose, 1 oz.; water, a sufficient quantity. Make a thick paste, roll into sheets, and cut into tablets. The balls, in bulk, can be obtained only in large packages of the manufacturers, say barrels of 200 lb.; but put up in 1-lb. boxes, they can be bought in cases as small as 28 lb. Where there is a trade for small packages there would apparently be a fair margin of profit in buying 28-lb. lots and putting them up in 1 and 2-oz. cartons. The term bag bluing simply indicates a solid blue, which, whatever its composition, is used by placing in a little bag, immersing this in water, and pressing out the liquid into the water to be blued.

f.—A Disinfectant Laundry Blue.—Mix together 16 parts of Prussian blue, 2 parts of carbolic acid, 1 part of borax, and 1 part of gum arabic into a stiff dough. Roll it out into balls as large as hazel nuts, and coat them with gelatine or gum to prevent the carbolic acid from escaping.

g.—Liquid Washing Blue.—Water, 15 parts; dissolve in this 1½ parts of indigo-carmine; add ¾ part gum arabic.

h.—Soluble Wash Bluing.—(1)—The following makes one of the best wash bluings known, and when prepared in quantity is very cheap: Dissolve 217 parts of potassium ferrocyanide in 750 parts of distilled water, and to the solution add sufficient water to make in all 1,000 parts. In another vessel dissolve 100 parts of ferric chloride in sufficient distilled water, and bring the solution up to 1,000 parts as before. Make a cold saturated solution of sodium sulphate in distilled water, and of the solution add 2,000 parts to each of the two iron solutions (making 3,000 parts of each). Now add the chloride solution to the ferrocyanide little by little, under constant stirring. After the last of the ferric chloride is added continue the stirring for some time. Filter off the liquid and wash the residue on the filter with distilled water until the wash water comes off a deep blue color. After washing, spread the mass out to dry, either at ordinary temperature or by artificial heat. When dry, a lump of this substance, which is soluble Prussian blue, breaks with a fine bronze-colored fracture. It is completely and easily soluble in water, hot or cold. With the addition of a little mucilage it makes, when dissolved in water, a beautiful blue ink, and may be also used for hand-stamp ink. As a laundry bluing it leaves nothing to be desired either in cost or quality.

(2).—Tablets of the First Quality.—Best (superfine) ultramarine, 40 parts; ordinary ultramarine, 20 parts; sodium carbonate, 40 parts; glucose, 12 parts. Mix, and make into tablets as directed further on.

(3)—Inferior Tablets.—Ultramarine, second quality, 50 parts; sodium carbonate, 50 parts; glucose, 12 parts. Still cheaper bluing may be made by using less ultramarine and more sodium carbonate, or by using cheaper coloring material (the so-called *blau-erde*), but the above will answer for the best and second-class trade. The glucose is diluted with water to 16° Baume, and if the tablets are to be made quite hard, either gum arabic, gelatine or dextrine should be added. As tablets made without any addition very easily contract moisture, an admixture of one or the other of the substances named is recommended. It is possible that cylinders might prove more acceptable than tablets. These should be wrapped in linen, or put into linen bags, so that in use the bag can be hung up in the water, thus giving a solution that will not need straining under any circumstances.

i.—Stick Bluing.—Aniline blue, soluble, 1 av.oz.; starch, powdered, 15 av.oz.; glucose syrup, sufficient. Mix the powders, and mix into a stiff paste with the liquid glucose, roll out into a thick sheet, and cut into cubes or roll into sticks, which are dried by a gentle heat.

2.—*Curtains.*—a.—Shake every curtain, or hang them on a line and brush them down with a soft-haired brush. Prepare a soaking liquid by melting a small quantity of borax in warm water, soak for an hour or two then squeeze between the hands to remove the superfluous water. Take some good soap and chip it in hot water, stir until all the soap is melted, and a fine lather produced. By this time the water will be moderately warm. Immerse the curtains in this, pass them repeatedly through the lathered water, or work them up and down. Rubbing should be avoided; when absolutely necessary, do it gently and without a brush. Squeeze out the soapy water and rinse in plenty of soft warm water. Wring carefully. Curtains should be dried quickly. If in the country, they may be spread to dry on clean grass. Otherwise, curtains are always better for being stretched and pinned to wooden frames while drying. It is advisable to use cooked starch for curtains. Use good starch, mix it thoroughly in warm water, which should be made to boil for 15 or 20 minutes. While cooling, add a very little indigo blue. This is only to be used for pure white curtains. The starch should be decidedly thick. Draw the curtains through the starch, squeeze out gently, and dry rapidly.

b.—Coloring.—Many persons prefer tinted curtains to pure white ones. If they have to be colored, do not put any blue in the starch, but use water that has been slightly tinted with coffee, for ecru curtains, tea for a more decided hue, or saffron for a yellow tint, for preparing the starch. A decoction of logwood may be used if you wish to give the curtains a delicate pink hue.

c.—The basis of these coloring starches is thus prepared: Soak 1 lb. of good white glue for 12 hours, using just enough water to make it into a jelly; dissolve this with boiling water, adding about 18 to 19 lb. of Paris white; add more water until the compound is diluted to the consistency of milk. This starch may be colored to taste. A little Prussian blue and vermilion (in the proportions of 2 to 1) gives a fine lilac. Raw umber and a pinch of lampblack gives a gray. Vermilion and red lead (in the proportion of 3 to 1) produces a tender rose. Indigo blue just tinted with vermilion gives a lavender. Chrome yellow and a pinch of Spanish brown gives lemon yellow. Indian yellow and burnt sienna (in the proportion of 2 to 1) gives a buff hue. Experiments should be tried, as some of the colors look very badly if they are dark.

3.—*Linen.*—a.—Bed Linen.—In a circular, the surgeon-general of the German army, Colan, in Berlin, calls the attention of heads of the garrison hospitals to a new cleaning method, which is to be employed in future, as thorough experiments have proved it to be of advantage. According to this method, petroleum is added to the water besides soap and soda, taking as many grams of it as there are liters of water used; *e.g.*, 30 grams of petroleum to 30 l. of water. This admixture of petroleum does not only admit of an easier cleaning, as well as less tear and wear on the linen, but the wash also retains its color, is thoroughly disinfected, and the expenses are considerably reduced by a saving in soap.

b.—Blistering, To Prevent.—Blistering is almost always due to bad starching, but occasionally to ironing the articles when too wet. Each article must be well starched through, and, when about to iron, damp it evenly, but do not wet it. Use a hot iron. Collars and cuffs that have to be turned down should be fixed in the proper shape immediately after each one is ironed, for then the starch is still flexible.

c.—Scorched, To Restore Whiteness.—Vinegar, ½ pt.; fuller's earth, 2 oz.; dried fowl's dung, 1 oz.; soap, ½ oz.; the juice of 2 large onions. Boil all these ingredients together to the consistency of paste; spread the composition thickly over the damaged part, and if the threads be not actually consumed, after it has been allowed to dry on and the place has subsequently been washed once or twice, every trace of scorching will disappear.

d.—Red-Bordered Towels and Napkins.—A little borax put in the water will prevent them from fading.

4.—*Shirts.*—a.—(Chinese Method.) A rather thick starch paste is prepared by first beating up a handful of raw starch, usually corn starch, and 1 teaspoonful of fine rice flour with about 1 qt. of water, making a liquid of creamlike consistency. A certain quantity (determined alone by personal experience) is poured into a quantity of boiling water while the latter is violently stirred with a short wooden spatula. With this the portions of the linen to be dressed are well smeared, the linen moist from wringing, and the starch quite hot. Thus smeared, the pieces are laid aside for a few minutes, then rubbed well between the hands, so that the paste is well distributed in the fabric. The linen is then usually dried by artificial heat. When ready for ironing, the starched portions are dampened by means of a cloth dipped in row starch water to which has been added a small quantity—about ½ oz. to the qt. of blood albumen—of clarified serum of bullock's blood. The proportion of starch in this water is usually about as 1 to 50 of water. In ironing, the irons are first made very hot, and cooled somewhat, externally, just before using by momentarily plunging them into a pail of water. The irons commonly employed are what are termed polishing irons—they have the posterior edge rounded instead of angular, as in the ordinary smoothing or sadiron. Much of the fine gloss observed on shirts laundried by Chinamen is accomplished by the skilful manipulation of this "rounded edge" over the work—a manipulation very difficult to describe in words. It is most laborious work for those not accustomed to it. It not only renders the surface glossy, but imparts easy flexibility to the heavily starched fabric otherwise not obtainable. Custom made shirts are usually laundried before delivery in trade at the factory, the ironing, in these cases, being largely performed by steam mangles, though some are hand-finished. The following recipe for a laundry starch is said to produce a very fine and lasting gloss on linen without the expenditure of the amount of labor in ironing usually requisite to produce a fair appearance: Corn starch, 1 oz.; boiling water, 1⅞ pt.; bluing q. s. To this, when it has cooled somewhat, is added, and thoroughly mixed in, about ½ oz. of the following preparation: Gum arabic, 8 3-5 parts; loaf sugar, 2½ parts; white curd soap, ¼ part; water glass ("A" syrup), 1 part; egg albumen, 4 parts; warm water, 20 parts. In preparing this, the first 3 ingredients are dissolved together in the water at boiling heat, the water glass is then added, and when the mixture has cooled down to about 150° F. the egg albumen is put in and the whole well beaten together.

b.—Starch, 1 oz.; paraffine, about 3 dr.; white sugar, 1 tablespoonful; table salt, 1 tablespoonful; water, q. s. Rub up the starch with soft water into a thick, smooth paste. Add nearly or quite 1 pt. of boiling water, with the salt and sugar dissolved in it, and, having dropped in the paraffine, boil for at least half an hour, stirring to prevent burning. Strain the starch, and use while hot. Sufficient bluing may be added to the water, previous to the boiling, to overcome the yellowish cast of the starch, if necessary. Spermaceti may be used in place of paraffine. Starched linen can only be properly finished by hard pressure applied to the iron.

c.—Glossed Shirt Bosoms.—Take 2 oz. of fine white gum arabic powder, put it in a pitcher, and pour on 1 pt. or more of water, and then, having covered it, let it stand all night. In the morning pour it carefully from the dregs into a clean bottle, cork, and keep it for use. A teaspoonful of gum water stirred in a pint of starch, made in the usual way, will give to lawns, white or printed, a look of newness when nothing else can restore them, after they have been washed.

d.—Melt 2½ lb. of the very best A1 paraffine wax over a slow fire. When liquefied, remove from the fire and stir in 100 drops of oil of citronella. Have some new round pie tins, place them on a level table, coat them slightly with sweet oil, and pour about 6 tablespoonfuls of the enamel into each tin. The pan may be floated in water to cool the contents sufficiently to permit the mixture to be cut or stamped out with a tin cutter into small cakes about the size of a peppermint lozenge. Two of these cakes added to each pint of starch will cause the smoothing iron to impart the finest possible finish to muslin or linen, besides perfuming the clothes.

e.—Take of white wax, 1 oz.; spermaceti, 2 oz.; melt them together with a gentle heat. When you have prepared a sufficient amount of starch in the usual way for a dozen pieces, put into it a piece of the polish about the size of a large pea; using more or less according to large or small washings. Or thick gum solution (made by pouring boiling water upon gum arabic) may be used. One tablespoonful to a pint of starch gives clothes a beautiful gloss.

5.—*Starches.*—a.—Relative Stiffening Strength of.—Starting with a pure starch obtained by maceration and infusion, and taking its stiffening power as 100, we obtain the respective value of other starches, thus: Pure, dry rice starch, 100; rice starch No. 1, 95; rice starch No. 2, 91; pure dry maize starch, 87; corn starch, 85; rye starch, 81; buckwheat starch, 81; oat starch, 80; acorn starch, 80; wheat starch, 80; barley starch, 78; Bermuda arrowroot, 75; Natal arrowroot, 73; pure potato starch, 68; potato farina, 65.

b.—Rub 1 oz. of best potato starch up with a little cold water, so as to reduce all the lumps; add 1 tablespoonful of best loaf sugar, an equal quantity of dextrine, a little soluble indigo, and a lump of pure paraffine about the size of a nutmeg. Then add 1 pt. of boiling water, and boil, with occasional stirring, for half an hour (not less). The starch should be strained through a linen cloth before using.

c.—To Improve Starch.—To each bowl of starch add 1 teaspoonful of Epsom salts, and dissolve in the usual way by boiling. Articles starched with this will be stiffer, and will be rendered, to a certain degree, fireproof. To use corn starch, boil to a smooth paste, cool, and starch the goods; dry quickly. Before ironing, dampen down in thin, raw (unboiled) starch water. A little gum arabic or pure white wax is often added to the boiled starch to afford a fine gloss. Iron in the usual way, with a common sad-iron; then dampen slightly with a clean cloth and the starch (raw) water, and polish briskly with a polishing iron.

d.—Black Starch.—Add to the starch a certain amount of logwood extract before the starch mixture is boiled. The quantity varies according to the depth of the black and the amount of starch. A small quantity of potassium bichromate dissolved in hot water is used to bring out the proper shade of black. In place of bichromate, black iron liquor may be used. It comes ready prepared. Preparations of this kind are used in various industries.

e.—Gloss, Cold Water.—Powdered borax, 25 parts; paraffine, 2 parts; powdered starch, 73 parts. Melt the wax, and pour on the borax in a warm mortar; mix well, and finally add the starch.

f.—Gloss, Liquid.—(1) Gum arabic and borax, 1 oz. of each, are dissolved in 10 oz. of water; white wax and spermaceti, 1 oz. of each, are melted, and, while liquid, are rubbed with the solution of borax and 10 drops of oil of cloves to make an emulsion, mixing them thoroughly. A teaspoonful of this mixture in 1 pt. of starch gives a fine polish. It may also be applied after starching, by rubbing over the starch with a cloth and then polishing with the iron.

(2) Borax, 2½ oz.; gum arabic, 2½ oz.; spermaceti, 2½ oz.; glycerine, 6¾ oz.; distilled water, 2¼ pt. A few drops of some sweet-scented essence. Add 6 spoonfuls of lustrine to 6¾ oz. of boiling starch.

(3) Borax, saturated solution, 2 parts; tragacanth mucilage, 1 part; mix; 1 tablespoonful to 1 pt. of starch.

(4) The *Seifenfabrikant* gives the following for polishing shirt bosoms, collars, etc.: Gum arabic, 4 parts; borax, 4 parts; glycerine, 6 parts; spermaceti, 3 parts; water, 60 parts.

(5) A. Dissolve white wax, 5.0%, in ether, 20.5%, and add alcohol, 75%; shake before using. B. Heat until melted, in a pot, 1 kgm. of wax and 1 kgm. of stearine, as well as a few drops of an essential oil. To the hot liquid add, with careful stirring, 250 grams of ammonia lye of 10%, whereby a thick, soft mass results immediately. Upon further heating the same turns thin again, whereupon it is diluted with 20 l. of boiling water mixed with 100 kgm. of starch, and poured into molds.

(6) Powdered starch, 30 parts; powdered borax, 15 parts; stearine, 1 part; alcohol, a sufficient quantity. Dissolve the stearine in alcohol, mix the solution with the starch, and leave exposed until the alcohol evaporates; then add the borax.

(7) Water, 70 gal.; fine wheat starch, 80 lb.; farina, 20 lb.; heavy magnesia, 10 lb.; white curd soap, 6 lb.; spermaceti, 5 lb.; Japan wax, 5 lb.; crystal carbonate of soda, 2 lb.; ultramarine blue, ½ lb. Dissolve the blue in the water; then melt the soap, spermaceti and wax, and add the soda, stirring well. Next mix starches and magnesia, free from lumps, with water; add others, and boil until thoroughly mixed. Then run through a strainer.

(8) Powdered starch, 2 dr.; powdered gum arabic, 1½ dr.; powdered borax, 1 dr.; glycerine, ½ dr.; water, 2 oz. Dissolve the gum arabic in the water, followed by the borax and the glycerine; then incorporate the starch, rubbing up to a homogeneous mixture, which should be strained afterward to exclude any lumps; add 1 tablespoonful of this mixture to 1 qt. of starch.

(9) The *Apotheker Zeitung* recommends the following: Pour 250 grams of water over 5 grams of powdered gum tragacanth until the powder swells uniformly; then add 750 grams of boiling water, dissolve 50 grams of borax in it, and stir 50 grams of stearine and 50 grams of talcum into the whole." Of this fluid, add ¼ l. to 1 l. of boiled starch, or else the ironing oil is applied by means of a sponge on the starched wash, which is then ironed.

(10) Glycerine, 2 fl.dr.; oil of turpentine, 2 fl.dr.; borax, 2 dr.; starch, 2 oz.; water, 12 fl.oz. Rub down the starch with water to a smooth paste and add the remainder of the water, in which the borax has been previously dissolved; then add the glycerine and oil of turpentine.

(11) Water, 14 pt.; turpentine, 4 pt.; Japan wax, 3 pt.; lemon rosin, 4 oz.; borax, 4 oz.; white curd soap, 4 oz. Dissolve the wax (sliced) and rosin in the turpentine; boil the soap and borax in the water; mix all, and churn well until amalgamated.

(12) A. Melt 5 parts of stearic acid, add 5 parts of absolute alcohol, and triturate the mixture with 95 parts of wheat starch. Starch prepared with this mixture takes easily a fine polish. The polishing irons should be thoroughly cleaned immediately after use. B. Spermaceti, 1¾ oz.; gum arabic, 1¾ oz.; borax, 1¾

oz.; glycerine, 4½ oz.; distilled water, 1½ pt. Boil half the water, and add the borax and spermaceti to it. Separately dissolve the gum in the remainder of the water and glycerine. Strain, and mix thoroughly with the warm mixture. This is a good gloss for cold-water starch; 1 wineglassful of it is used with 4 oz. of dry starch.

g.—Gloss Powder.—(1) Gum arabic, powdered, 3 parts; spermaceti wax, 6 parts; borax, powdered, 4 parts; white corn starch, 8 parts. Mix intimately in the powder form by sifting through a sieve several times. As the wax is in a solid form, and does not readily become reduced to powder by pounding in a mortar, the best method of reducing it is to put the wax into a bottle with some sulphuric or rectified ether, and then allow the fluid to exaporate. After it has dissolved the wax, as the evaporation proceeds, the wax will be deposited again in the solid form, but in fine, thin flakes, which will easily break down to a powder form when rubbed up with the other ingredients in a cold mortar. To use, add 4 teaspoonfuls per pound to all dry starch, and then make the starch in the usual way as boiled starch.

(2) Spermaceti, 1 oz.; borax, 1 oz.; starch, 4 oz. Reduce the spermaceti to a fine powder by the aid of a little alcohol, and mix with the powdered borax and starch.

(3) Starch, by weight, 1,044 parts; borax, by weight, 9 parts; common salt, by weight, 1 part; gum arabic, by weight, 8 parts; stearine, by weight, 20 parts.

(4) Bleached carnauba wax, 30 parts; powdered French chalk, 20 parts; white Castile soap, 12 parts. Shave the soap, and melt with the wax; stir in the chalk while cooling.

(5) Soap flakes, 44 lb.; powdered borax, 5 lb.; powdered French chalk, 4 lb. Spread the flakes out, sift borax and chalk over, moving about, to well and evenly distribute. Any kind of white soap may be utilized by first reducing to a granular form, then passing through a pair of rollers to form flakes.

(6) Powdered borax, 8 oz.; potato starch, 1 oz. Take 1 teaspoonful with each heaped tablespoonful of ordinary starch used.

(7) Borax, 24 parts; farina, 21 parts; white dextrine, 20 parts; white soap, 3 parts. A tablespoonful of this is required for 1 lb. of starch.

(8) White wax, 2 oz.; spermaceti, 4 oz.; stearine, ½ oz.; ultramarine blue, 3 gr. Melt together, and let cool. For doing up 1 doz. shirts, put a piece the size of a hazelnut in the hot starch, and mix. The boiling water serves to emulsify the waxy substance of the mixture. Finish with a hot iron the usual way.

(9) Boric acid, 5 parts; borax, 3 parts; stearine, 1 part; white beeswax, 1 part. Put into a capsule, add sufficient of a solution of sodium hydrate (liquor sod. causticus) of 20° B., and boil until a homogeneous liquid is obtained; then evaporate to dryness under a low heat. The dry product is then mixed with the finest rice starch, in the proportion of 1 part to 10 parts of starch. This produces the so-called "Glanzstarke" used in the finest German laundries. Properly prepared, and properly applied, the preparation leaves nothing to be desired, either in the polish or stiffness of the laundry clothing.

h.—Linen Polishing Block.—Bleached carnauba wax, 30 lb.; powdered French chalk, 21 lb.; powdered Castile soap, white, 12 lb.; citronella, 2½ oz. Convert the soap and wax into shavings, melting at a gentle heat; then stir in the chalk and citronella oil when a little cooler; then pour out into a mold to set.

i.—Uninflammable Starch.—Sodium tungstate, 2 oz.; borax, in powder, 2 oz.; starch, 6 oz.

6.—*Washing Preparations.*—a.—Brick.—Water, 54 parts; sodium hydrate, 38.21 parts; sodium biborate, 6.61 parts; sodium silicate, 1.70 parts.

b.—Cream.—I. First quality white soft soap, 320 parts; pulverized Castile soap, 80 parts; oil of sesame, 20 parts; well purified, and perfumed with 5 parts of lemon-peel oil. II. Potash soft soap, 250 parts; best soda soap, 120 parts; olive oil and water, each, 60 parts; potash, 7 parts. III. Oil soap, 60 parts; dry soap powder, 30 parts; honey and rose water, 15 parts, as much as necessary to obtain a fine foaming product. IV. Lard, 8 parts; cocoanut oil, 2 parts; sapoified in a water bath with 2½ parts of 40% potash lye, colored pink, and scented with rosewood oil and with oil of bergamot. V. Best lard, 30 parts; oil of sesame, 6 parts; melted together; and to this fat, at a temperature of 100° F., 5 parts of 40% caustic potash lye, previously mixed with 1 part of water, is added in a thin stream; after which 14 parts of 40% caustic potash lye are stirred in, in the same manner. The soap mass is then heated in a water bath of moderate temperature, in which, while stirring, complete saponification is effected.

c.—Liquids.—(1) Take 3 lb. of bar

soap, shave fine and add 1 qt. of lye, ¼ oz. of perlash, dissolved over a slow fire. When dissolved, put into a vessel prepared for it to stand in; then add ¼ pt. of turpentine, 1 gill of hartshorn; stir well, and it is ready for use.

(2) Dissolve ½ lb. of soda in 1 gal. of boiling water, and pour upon it ¼ lb. of lime. After this has settled, cut up 10 oz. of common bar soap and strain the solution upon it, and mix perfectly. Great care must be taken that no particles of lime are poured upon the soap. Prepare the mixture the evening before washing. Directions: To 10 gal. of water add the above preparation when the water is boiling. Each lot of linen must boil half an hour, and the same liquid will answer for three batches of clothes. The white clothes must be put in soak overnight, and if the collars and wristbands are soaped and rubbed slightly, so much the better. Clean cold water may be used for rinsing. Some prefer boiling them for a few moments in clean bluing water and afterward rinsing in cold water.

(3) The following compound is said greatly to facilitate the washing of clothes: Dissolve 2 lb. of bar soap in about 3 gal. of water as hot as the hand can bear; add 1 tablespoonful of turpentine and 3 tablespoonfuls of ammonia; stir, and steep the clothes in this for 3 hours, keeping the vessel tigtly covered. Then wash the clothes in the usual way. The soap and water may be used a second time, in which case a teaspoonful of turpentine and the same amount of ammonia must be added. This treatment is calculated to save much labor in cleansing summer clothes stained by fruit, etc.

(4) The German washerwomen use a mixture of 2 oz. of turpentine and 1 oz. of spirits of ammonia, well mixed together. This is put into a bucket of warm water in which ½ lb. of soap has been dissolved. The clothes are immersed for 24 hours, and then washed. The cleansing is said to be greatly quickened, and 2 or 3 rinsings in cold water remove the turpentine smell.

(5) Borax is valuable for laundry use, instead of soda. Add a handful of it, powdered, to about 10 gal. of boiling water, and you need use only half the ordinary allowance of soap. For laces, cambrics, etc., use an extra quantity of the powder. It will not injure the texture of the cloth in the least.

(6) The following was recommended in a German medical journal as being the most efficient and least harmful: Soda (sodium hydrate), 150 parts; rosin, 75 parts; white soap shaved up, 50 parts; alum, in coarse powder, 50 parts; sodium carbonate, commercial, 290 parts; sodium or potassium silicate, 290 parts; water, 600 parts. Bring the water to a boil, and in it dissolve the silicate and add the rosin. As soon as solution takes place add the remaining substances. A tablespoonful is said to be sufficient for an "ordinary wash.". You can easily determine the quantity necessary by a few experiments.

(7) Sodium carbonate, in concentrated solution,, rendered caustic by agitation with slaked lime. Must be used with discretion.

(8) Alcohol, 8 parts; oil of turpentine, 8 parts; strongest solution of ammonia, 1 part.. Mix. Use 3 or 4 tablespoonfuls to 1 pt. of soft soap or 1 lb. of hard soap. The clothes should be soaked overnight, if possible, before using this mixture; but if soaked an hour or two it will aid much.

(9) Washing fluid for fine linen, laces, etc.: Borax, 1 part; water, 160 parts. For crinoline, or any stiff fabric, increase the quantity of borax to 6 oz.

(10) Nottingham washing liquor: Water, 42 parts; white soap, 8 parts; potassium carbonate, impure, 1 part.

(11) Hull washing liquor: Yellow soap, 3 parts; water, 256 parts; strongest solution of ammonia, 8 parts.

(12) Yorkshire wash: Strongest solution of ammonia, 1 part; common water, 16 parts.

(13) Silicate of soda or potash, or water glass, is in itself a good detergent. It is added to cheap soaps to permit the retention of large quantities of water in the finished product. When dissolved in hot water it forms a solution which unites with certain kinds of soap very readily (curd soap, yellow soap, and soaps containing rosin). Probably a useful washing liquor could be made from this substance.

(14) The following, according to Charles Boettiger, in the *Revue de chimie industrielle*, is the formula for preparing an article which, it is claimed, cleans at one washing, and without the use of scrubbing boards, brushes, etc., all kinds of wash goods, and is absolutely harmless to all species of fabrics linen, woolen, cotton, etc.: Potassium hydrate, 8 grams; alcohol, 20 grams; olein, 24 grams; glycerine (or vaseline), 2 grams; turpentine, 4 grams; ultramarine, 2 grams; water, 100 l. Mix. Take of the mixture sufficient for the laundry in hand, put it into the wash kettle and add about

one-third of the amount of lye ordinarily used for the wash; mix, and bring to a boil, and let boil for 2 hours. The clothing will be found absolutely clean. Boiling may be avoided, if, instead of cold water, a warm suds be employed, and the clothing be scrubbed or beaten. We understand that 60 grams of the mixture is to be used for every 100 l., and more or less in proportion for any amount more or less than that.

(15) Jackman's washing compound: Sal soda, 6 lb.; borax, 1 lb.; dissolve in 1 gal. of boiling water. When cold, add 1-3 lb. of potassium carbonate, 3 oz. of liquid ammonia, 4 spoonfuls of alcohol. Boil for 5 minutes ¾ lb. fresh, unslaked lime in 1 gal. of water. Draw off the clear fluid when thoroughly settled; add to this the other ingredients, with 9 gal. of cold water. Directions for using: Soak the clothes overnight, after rubbing soft soap on the dirty places. In the morning add ½ pt. of the compound, ½ pt. of soap and 4 gal. of hot water. Boil not more than 5 minutes, and turn into a tub, putting into your boiler the same mixture as before. Wring the clothes into this, and boil again 10 minutes; suds, blue, and hang them out to dry. Should the wristbands or parts that are very dirty need a little rubbing, it should be done while the mixture is boiling.

(16) Javelle water, used for turning white the dirtiest linen, and removing stains, is composed of bicarbonate of soda, 4 lb.; chloride of lime, 1 lb. Put the soda into a kettle, over the fire, add 1 gal. of boiling water, let it boil from 10 to 15 minutes, then stir in the chloride of lime, avoiding lumps. Use when cool. This is good for removing fruit stains from white underwear.

(17) Peerless washing fluid: Ground soap bark, 8 oz.; borax, 4 oz.; concentrated potash lye, 1 lb.; white bar soap (ivory), ½ lb.; oil of turpentine, 2 oz.; ammonia water, 1 pt.; oil of sassafras, ½ oz.; boiling water, 1 gal. Shave the soap and dissolve in the boiling water; add the soap bark and borax, stirring them well together frequently for half a day, then strain, and add the concentrated lye, oils and ammonia water, shaking them well together. A tablespoonful for each gallon of water in which the clothes are put to soak.

d.—Powder.—(1) A German soap journal gives the following processes: Figged (soft) soap, 25 lb.; linseed-oil soap, 20 lb.; soda ash, 65 to 70 lb. The above are crutched together, whereby the mixture becomes heated; the mass is then turned with a spade, at short intervals, until it disintegrates in small pieces. After cooling, it is rubbed through a fine sieve, and the powder is then ready to be packed. This process is recommended for small businesses, as it rquires no mill to be used.

(2) For large quantities the boiling process is better adapted, but it requires the use of a mill. Here is the formula: Red oil, 350 lb.; soda lye, 40° B., 140 lb.; soda ash, 70 lb.; water, 280 lb. After saponifying the above, and shutting off the heat, add 350 lb. of soda ash by constant crutching. By continuing the crutching a gritty mass is obtained, which is run into a wooden, tin-lined box about 12 in. high, and there still crutched till cold. Recently, soap powder has been brought on the market with an odor of ammonia, turpentine, and sometimes also perfumed. These ingredients may be incorporated while stirring in the box. On cooling, the now very solid mass must be ground in the mill and sifted. Powder carefully made in this way, it is said, does not expand while stored, and the bursting of the packages is not to be feared.

(3) A cheaper powder is made by the same process from the following: Palm kernel oil, 135 lb.; palm oil, 20 lb.; soda lye, 40° B., 100 lb.; water, 800 lb.; to which are added soda ash, 1,050 lb.

(4) Gathmann (American soaps) says that washing powders usually sold to the consumer as soap powders may be described in a general way as mixtures of powdered soap with about its own weight, more or less, of carbonate of soda. Some special brands are made which, in addition, contain other detergent agents, such as carbonate of ammonia, sal ammoniac or borax, while still others are found to which filling, in the form of talc, silex, etc., has been added. The soap itself may have been made by any of the processes known—cold, half boiled, or boiled, settled or boiled down—and the stock used may have been any fat, or mixture of fats, according to the grade of the washing powder to be made. It is thus seen that beyond being either principally or entirely a mixture of soap and soda, these powders have little in common with each other. Here are some typical formulas:

(5) Hager; in *Phar. Centralhalle*, gives the following 9 analyses:

(a) The so-called English Washing Crystal is an impure, half effervescent crystallized soda, containing a large proportion of sulphate of soda and common salt.

(b) Under the name of Washing Crystals, simply a filtered solution of borax and soda has been introduced.

(c) The English Patent Cleansing Crystal Washing Powder is a half efflorescent soda, containing about 25% of Glauber's salts.

(d) The Washing and Cleansing Crystals are pure crystallized soda, with 1 to 2% of borax.

(e) Krimmelbein's Wool Washing Composition is a mixture of 35 parts of dried soda, 10 parts of soap powder and 10 parts of sal ammoniac.

(f) Ward's Wool Washer is a mixture of 90 parts of effloresced soda crystals with 10 parts of soap powder.

(g) The Universal Washing Powder (Henkel's) is a water glass containing soda, with a small percentage of tallow soap and starch powder.

(h) Hudson's Soap Extract is a mixture of crystallized soda and soda soap, containing water (soap 14.3, anhydrous soda 30, and water 55).

(i) A washing powder for the finest white linen is a powdery mixture of 90 parts of effloresced soda with 10 parts of hyposulphite of soda and 2 parts of borax.

(6) Heat soluble soda glass, 5,000 parts, and mix intimately with calcined soda, 2,000 parts. The resulting hard mass is broken up in a pounding machine.

(7) Soluble soda glass, 2,500 parts; calcined soda, 3,500 parts; powdered borax, 300 parts; powdered soap, 400 parts; potato starch, 300 parts.

(8) Powdered soda crystals, 8,000 parts; sodium silicate, 2 parts; borax,

(9) Hard soap, 5 parts; soda ash, 3 parts; sodium silicate, 2 parts; borax, 1 part.

(10) Yellow soap, 12 parts; pearlash, 3 parts; palm oil, 2 parts.

(11) Hard soap, 4 parts; sal soda (crude sodium carbonate), 3 parts; sodium silicate, 2 parts.

(12) Boraxine. (a) Sodium carbonate, partially effloresced, 2 parts; soda ash, 1 part.

(b) Sodium carbonate, partially effloresced, 6 parts; soda ash, 3 parts; yellow soap, 1 part.

(c) Sodium carbonate, partially effloresced, 3 parts; soap bark, 1 part.

(d) Sodium carbonate, partially effloresced, borax and yellow soap, equal parts of each.

The following directions are given in an article on this subject in *Der Seifenfabrikant*: "A very good powder can be made from 100 parts of crystal soda, 25 parts of dark yellow rosin curd soap and 5 parts of soft soap. The two latter are placed in a pan, along with half the soda (the curd soap being cut into small lumps), and slowly heated, with continual crutching, until they are thoroughly melted, without, however, beginning to boil. The fire is then drawn, and the remaining soda crutched in until it, too, is melted, this being effected by the residual crutching, until they are thoroughly will be fairly thick by the time the soda is all absorbed. After leaving a little longer, with occasional stirring, the contents are spread out on several thin sheets of iron in a cool room, to be then turned by the shovel at short intervals, in order to further cool and break down the mixture. The soap will then be in a friable condition, and can be rubbed through the sieve, the best results being obtained by passing through a coarse sieve first and one of finer mesh afterward. With these ingredients a fine yellow-colored powder will be obtained. White stock soap may also be used, and, if desired, colored with palm oil or the same colorings as are used for toilet soaps. The object of adding soft soap is to increase the solubility and softness of the powder, but the proportion used should not exceed one-third of the hard soap, or the powder will be smeary and handle moist. The quality of the foregoing product is good, the powder being stable, and not liable to ball, even after prolonged storage; neither does it wet the paper in which it is packed, nor swell up, and therefore the packets retain their appearance. In making ammonia-turpentine soap powder the ammonia and oil of turpentine are crutched into the mass shortly before removing it from the pan, and if the powder is scented—for which purpose oil of mirbane is mostly used—the perfume is added at the same stage."

(13) London Soap Powder: Yellow soap, 6 parts; soda crystals, 3 parts; pearlash, 1½ parts; sulphate of soda, 1½ parts; palm oil, 1 part. These ingredients are combined as well as possible without any water, and they are spread out to dry, and then ground into coarse powder. They are adapted to hard waters, as their excess of carbonated alkali neutralizes the lime in the water.

(14) Pearl Soap Powder: Curd soap, powdered, 4 parts; sal soda (crude sodium carbonate), 3 parts; sodium silicate, 2 parts. Dried as much as possible, and intimately mixed.

***Wringers, To Fasten Rolls on.*—1.—**

Clean shaft thoroughly between the shoulders or washers, where the rubber goes on.

2.—Give shaft a coat of copal varnish between the shoulders, and let it dry.

3.—Give shaft a coat of varnish and wind shaft tightly as possible with 5-ply jute twine at once, while varnish is green, and let it dry for about 6 hours.

4.—Give shaft, over the twine, a coat of rubber cement, and let it dry for about 6 hours.

5.—Give shaft, over the twine, a second coat of rubber cement, and let it dry for about 6 hours.

6.—Remove washer on the short end of shaft, also the cogwheel, if the shaft has cogs on both ends.

7.—See that the rubber rolls are always longer than the space between the washers, where the rubber goes on, as they shrink or take up a little in putting on the shaft.

8.—Clean out the hole or inside roll with benzine, using a small brush or swab.

9.—Put the thimble or pointer on the end of shaft that the washer has been removed from, and give shaft, over the twine and thimble, another coat of cement, and stand the same upright in a vise.

10.—Give the inside or hole of roll a coat of cement with a small rod or stick.

11.—Pull or force the roll on the shaft as quickly as possible, with a jerk, then rivet the washer on with a cold chisel.

12.—Let roll stand and get dry for 2 or 3 days before using same. Cement for use should be so thick that it will run freely; if it gets too thick, thin it with benzine or naphtha.

Lead, To polish.

Use jeweler's rouge on a chamois skin.

Linoleum and Oilcloth.

1.—Wash the linoleum with a mixture of equal parts of milk and water, wipe dry, and rub in the following mixture by means of a cloth rag: Yellow wax, 5 parts; turpentine oil, 11 parts; varnish, 5 parts. As a glazing agent, a solution of a little yellow wax in turpentine oil is also recommended. Other polishing agents are:

a.—Palm oil, 1 part; paraffine, 18 parts; kerosene, 4 parts.

b.—Yellow wax, 1 part; carnauba wax, 2 parts; turpentine oil, 10 parts; benzine, 5 parts.

c.—Rub them once in 3 months with boiled linseed oil. Put on a very little, and rub it well in with a rag, and polish with a piece of old silk.

2.—Wash with a large, soft woolen cloth and lukewarm or cold water; dry thoroughly with a soft cloth, and afterward polish with milk or a weak solution of beeswax in spirits of turpentine. Never use a brush or hot water or soap, as either will be apt to bring off the paint.

3.—*To Renovate.*—Dissolve 2½ lb. of paraffine and 1 gal. oil of turpentine by the aid of a gentle heat, and apply with a sponge or piece of flannel, while warm. Let it remain on the oilcloth twenty-four hours; then polish with flannel. This solution not only renovates, but preserves the cloth. It has been used on oilcloths which have been down 4 years, and they look as good as new. The same preparation may also be used on painted floors. When rubbed with flannel it will have a beautiful gloss, equal to varnish.

4.—*Treatment of Newly Laid Linoleum.*—The furniture should never be rolled or skidded about, but lifted and carried from place to place; moreover, under the feet of heavy pieces on castors, small bits of linoleum should be placed. The proper way to cleanse a linoleum flooring is first to sweep off the dust and then wipe up with a damp cloth. Several times a year the surface should be well rubbed with floor wax. Care must be taken that the mass is well pulverized and free from grit. Granite linoleum and figured coverings are cleansed without the application of water. A floor covering which has been treated from the beginning with floor wax need only be wiped off daily with a dry cloth, either woolen or felt, and afterward rubbed well with a cloth well filled with the mass. It will improve its appearance, too, if it be washed several times a year with warm water and a neutral soap.

Liquors, Alkaline.

Try a little ammonia or the juice of a lemon. If the color is destroyed, nothing can be done.

Machinery.

1.—Blotting paper has been found very efficacious in the removal of grease.

2.—On machines greased with fat oils, the oil resinifies upon long idleness of the parts, so that their running is rendered very hard, especially for hand power. Regreasing with oil does not do much good, and a thorough cleaning of the resinified places, bearings, eccentrics, shafts, etc., is necessary. Petroleum is known to have been used for dissolving the resinified oils, but is only useful for easily accessible, smooth parts, and even here with considerable difficulty. In cases where there are hollows, oil holes, grooves, etc., rubbing with petroleum is insufficient. In such cases a strong soda solution is recommended. Take about 10 to 15 grams of caustic soda or 100 grams of soda for each liter of water, cause the solution to boil, immerse the parts to be cleaned in this and bathe them in it for some time; or, what is still better, boil them with it. The success will be so pronounced that only a rinsing and drying remains necessary to clean the machine parts. For small shops this mode of cleaning is doubtless the best.

Marble.

Discolored.—1.—Frequently, when marble is exposed, as in a cemetery, where it is more or less sheltered by trees, it is disfigured by lichens and other vegetable growth. In many instances this growth has died and become brown or black in color. All such discolorations may be readily removed by soda lye of moderate strength, about 5%. That which is rotted is dissolved, and the remainder is soon disintegrated. The following directions answer well: A box of concentrated lye, containing about 12 oz. of caustic soda, is dissolved in a 2-gal. bucket of water. Spread this over the stone with a small, cheap scrubbing brush made with vegetable fiber, preferably provide with a handle, so as to avoid getting the lye upon the hands, the clothes or the shoes. After 10 minutes or more pour water over the stone to wash off most of the lye, and then rub it a little with the brush, using some sand, if necessary, and the stain will be removed. Of course, this liquid has no effect upon the stone itself, and is most easily washed away. So far as the wash falls upon the ground, it will improve rather than harm any grass or other plants. Should the lye remain upon the skin, it may occasion an ugly sore. If splashed upon the clothing, the prompt application of a solution of sal ammoniac will prevent corrosion of the goods.

2.—If the marble is merely worn, and not stained, acids should not be used. Wash the surface with a mixture of finely powdered pumice stone and vinegar, and leave it for several hours; then brush it hard, and wash it clean. When dry, rub with whiting and wash leather.

3.—Soft soap, 4 parts; whiting, 4 parts; sodium bicarbonate, 1 part; copper sulphate, 2 parts; boil the whole together for 15 minutes. Mix thoroughly, and rub over the marble with a piece of flannel, and leave it on for 24 hours; then wash it off with clean water, and polish the marble with a piece of flannel or an old piece of felt.

4.—Soft soap, ¼ lb.; whiting, ¼ lb.; carbonate of soda, 1 oz.; make into a paste, and rub over the marble; wash it off after 24 hours.

5.—Sodium carbonate, 2 oz.; chlorinated lime, 1 oz.; water, 14 oz. Mix well, and apply the mixture (magma and liquid) to the marble with a cloth, rubbing well in, and finally rubbing dry. It may be necessary to repeat the operation.

6.—Oxgall, 1 part; saturated solution of sodium carbonate, 4 parts; oil of turpentine, 1 part; pipeclay, enough to form a paste.

7.—Wash the marble thoroughly with soda and warm water to remove any grease, then apply oxalic acid by laying a piece of white cotton cloth, saturated, upon the spots for a short time. If it destroys the polish, repolish with oxide of tin and water applied with a cloth. If the stains are not deep, rub the surface only with oxalic acid and water, upon a small piece of cloth, quickly, and wash to free the marble of acid. To give the marble a gloss, rub with chalk wet with water.

8.—Cover the soiled part with a paste of quicklime moistened with a strong, aqueous solution of sal soda for several hours; then remove the paste, wash the parts thoroughly, and polish, if necessary.

9.—Pure beeswax, 10 parts; japan gold size, 2 parts; spirit of turpentine, 88 parts. Dissolve, and apply in small quantities, by rubbing with a piece of flannel. If the marble to be cleaned is white, white wax may be used in making the preparation.

10.—Powdered pumice, 1 oz.; prepared chalk, 2 oz.; dried carbonate of soda, 1 oz. Mix, and make into a paste with equal parts of water and glycerine. It is used by rubbing a moist rag on the surface of the paste and then applying to the marble surface, and finally washing off with soap and water.

11.—*Grease and Oil.*—a.—Prepare a thin pulp of Spanish white, mix with benzine or petroleum ether, spread the mixture over the marble, and allow it to remain there, covered with a damp cloth, for 6 or 8 hours. If the spots are old, the process must be repeated several times. If benzine alone does not produce the desired result, a little chloroform should be added. To polish the slabs, use a mass of washed emery and tin putty, spread on a linen rag.

b.—To remove oil stains, apply common clay, saturated with benzine. If the grease has remained in long, the polish will be injured, but the stain will be removed.

c.—Use a mixture of equal parts of whiting, sodium bicarbonate and water. Apply with a sponge or cloth, rub well, and clean off with water. This is very useful around the fountain where cream has been used.

d.—To extract oil from marble or stone, soft soap, 1½ parts; fuller's earth, 3 parts; potash, 1½ parts; boiling water to mix. Apply to the grease spots, and let it remain 2 or 3 hours.

12.—*Iron Mold or Ink Spots.*—Dissolve ½ oz. of butter of antimony and 1 oz. of oxalic acid in 1 pt. of rain water; add enough flour to bring the mixture to a proper consistency. Lay it evenly on the stained part with a brush, and after it has remained for a few days wash it off and repeat the process if the stain be not wholly removed.

13.—Boil your marble in a strong solution of caustic soda, then take out and rub well. Soon all the stains will come out.

14.—*Match Stains.*—Spots from sulphur and phosphorus, caused by lucifer matches, can be extracted from marble by carbon bisulphide; or take 2 parts of common soda, 1 part of pumice stone and 1 part of finely powdered chalk; sift it through a fine sieve, and mix it with water; then rub it well all over the marble, and the stains will be removed; then wash the marble over with soap and water, and it will be as clean as it was at first.

15.—*Petroleum.*—Soda, 2 parts; finely powdered pumice stone, 1 part; finely powdered lime, 1 part; made into a paste with water. This is rubbed on the spots, allowed to remain a few minutes, and then washed off with soap and water.

16.—*Ointment Slabs and Greasy Mortars.*—These are easily and thoroughly cleaned by rubbing with ordinary newspaper wrung out in hot or cold water.

17.—*Polishing.*—Where the marble has been exposed to the weather, or has been more than commonly damaged, it may be necessary to repolish it. Rub it first with sharp sand; apply a second, and finally a third sand, of increasing fineness, after which use tripoli or pumice. The final polish is imparted by the use of tin putty or putty powder. A plate of iron is generally used for rubbing with the coarse sand; with the fine sand or emery a leaden plate is used; and for the powdered pumice a piece of smooth-grained pumice is employed. For the final polishing, coarse linen or bagging is used, wedged tightly into an iron planing tool. All of these substances are used while a stream of water trickles over the surface of the stone. The putty powder referred to is a binoxide of tin, obtained by treating metallic tin with nitric acid, when the metal is converted into hydrated metastannic acid, which, when it is heated, becomes anhydrous. It is in this condition that it is known as putty powder. In practice, putty powder is mixed with alum, sulphur and other substances, the mixture used being dependent upon the nature of the stone to be polished.

18.—*Rust.*—Muriatic acid will remove iron rust from a marble or porcelain bowl. If the bowl can be made hot, the stain will yield to the acid more quickly than when the surface is cold. Fill the bowl or tub with hot water and then empty; moisten the spot with the acid, pour boiling water over it, and it will disappear. When all the stains have been removed, rinse with ammonia and water; then rinse thoroughly with cold water. Work as quickly as possible with marble, as the acid is apt to dissolve it. Sometimes a stain which looks like rust, but is not, will not yield to this treatment, but will disappear if rubbed with wood alcohol.

19.—*Soda Fountain Care.*—The action of acids, viz., sulphuric, carbonic, citric, phosphoric, lactic, etc., or the fumes emitting therefrom, employed in carbonating and dispensing soda water, attacking marble, is very injurious to its polish; the front of the apparatus, marble slabs, etc., exposed to the spattering of soda water in which one or more of these acids are present, should be immediately rinsed with water and afterward rubbed quickly with a clean, soft cloth until perfectly dry. Frequent applications of pure olive oil to black or fancy marbles, rubbed vigorously with a soft, smooth fabric, will assist toward retaining their original appearance. Under no circumstances should oil or soap be applied to onyx, Italian white, French blue or Bardillo marbles. Stone of this description should be washed frequently with pure water and afterward rubbed briskly with a clean chamois until it assumes a glossy appearance. A saturated solution of beeswax in turpentine, rubbed into the pores of highly colored marble showing signs of dimness, and afterward removed by rubbing it smartly with a soft, smooth cloth, will restore its original luster. Light-colored marbles, and especially onyx, should be kept dry and bright by burnishing the surface frequently with a clean chamois. To prevent Belgium black marble from turning gray, it should be oiled, and rubbed freely at least once a week. By keeping the pores of marble filled with oil a film is formed over the surface, which becomes almost impervious to the action of acids, etc.

20.—*Stovepipe Drippings.*—Cover with a thick layer of powdered French chalk, previously well moistened with benzine. The cover over to prevent evaporation of the benzine. After 5 to 6 hours the chalk and benzine are removed and a fresh layer applied, and this is continued until the spots have disappeared. If the benzine is not successful, a little chloroform may be added, but no acid should be used, as it acts upon the marble.

21.—*White Marble.*—a.— Coat it with gum arabic and expose to the sun. When it peels off, wash with water, or make a paste with fuller's earth and hot water, cover the spots therewith, and let it dry on; and next day scour off with soft soap. The luster can be restored by rubbing with a dry cloth.

b.—Oxgall, 1 oz.; lye, 1 gill; turpentine, 1½ tablespoonfuls; mix, and make into a paste with pipeclay; put the paste over the stain, and let it remain for several days.

Matting.

Wash with water in which bran has been boiled, or in weak salt and water; dry it well with a cloth.

To Remove Grease from Matting.—Wet a nail brush in slightly salted water, rub on Castile soap, and scrub the place. Have the water boiling. Continue to scrub with soap till the spot disappears. Wash with clean cloth, and rub dry. Always rub lengthwise of the grain.

Metals. (See also **Brass and Copper; Iron and Steel; Nickel; Rust; Silver;** in this chapter.)

1.—The preparation of polishes, simple as it sems, is an art, and, like every other, requires a certain amount of practical experience as well as a knowledge of the materials entering into the composition of the polishing mixture used, and of their preparation for use. To attain a high and uniform grade of polish, the materials must be reduced to a very fine and uniform powder. One single grain of the material large or sharper than the rest will produce scratches that interfere with the finish given the metal. The substances in general use are prepared chalk rotten stone, tripoli and emery. For the finest work, jewelers' rouge is employed. Substances like emery are most useful for the harder metals; they scratch too much to be used to any extent on gold or silver. All should be run through a fine sieve before being used.

2.—*Cloths, Polishing.*—These are undyed velveteen, in the stage of manufacture known as "dressed off." They may be improved by soaking in a solution of ammonia or a saturated solution of hyposulphite of soda, then dried. Polishing tissue was thin paper, saturated with ammonia solution and dried; it is now obsolete.

3.—*Jewelers' Polishing Bar.*—Refined tallow, 80 lb.; sesquioxide of iron, 16 lb.; oxalic acid, 1 lb. Powder the acid, mix with the sesquioxide, and mold with the tallow into bars, like soap. The sesquioxide must be quite free from grit, or it may scratch valuable work. It may be prepared by calcining equal amounts of oxalic acid and iron sulphate in a crucible for about 15 minutes, with a good draught.

4.—*Jewelers' Rouge.*—To make sure of your jewelers' rouge being free from dust and grit, prepare it fresh, as follows: Make a solution of iron sulphate (copperas), and another of oxalic acid. Add the latter to the former, as long as it throws down a precipitate. Filter off the liquid, and wash the residue on the filter with repeated charges of water, and dry. When dry, place in a suitable container, and heat gently. It soon ignites, and burns until only an impalpable powder is left. This is the polishing material. The infusorial earth must be freed from sand, grit, etc., and reduced, by grinding, to a condition similar to that of the iron peroxide The rotten stone and acid must also be powdered. If care and attention be given to these details, you can scarcely fail to get good results.

5.—*Liquid Polish.*—Sometimes it is desirable to have a liquid polish for metals. Properly speaking, there can be no such thing, as the polishing process depends, as we have already pointed out, on the attrition of fine particles of some substance a little harder than the metal. The powders used can be, and frequently are, employed in a moist condition, and they may be suspended in water by shaking. A mixture of whiting and ammonia water is frequently used in cleaning metals, the ammonia acting as a solvent of some kinds of dirt. It is best, however, to remove grease, etc., before beginning the polishing process, and the effects of strong alkalies on the hands are not pleasant. It is true that the acids, by their chemical action, remove rust and dirt from metallic surfaces without the aid of any of these hard, fine powders, but they generally remove also a portion of the metals themselves each time they are applied. A weak solution in water of any of the strong mineral acids, or even of citric or oxalic acid, might be found useful in a number of instances, but could not be recommended for general use.

a.—Prepared chalk, 2 parts; water of ammonia, 2 parts; water, sufficient to make 8 parts. The ammonia saponifies the grease usually present. It must be pointed out that the alkali present makes the preparation somewhat undesirable to handle, as it will affect the skin if allowed too free contact.

b.—Malt vinegar, 4 gal.; lemon juice, 1 gal.; paraffine oil, 1 gal.; kieselguhr, 7 lb.; powdered bath brick, 3 lb.; oil of lemon, 2 oz. Well mix.

c.—Kieselguhr, 56 lb.; paraffine oil, 3 gal.; alcohol, 1½ gal.; camphorated spirit, ½ gal.; turpentine oil, ½ gal.; liquid ammonia fort., 3 pt. Pour the ammonia into the oil, alcohol and turpentine, add the camphorated spirit, and mix with the kieselguhr. To prevent setting, keep well agitated during filling. The color may be turned red by using a little sesquioxide of iron and less kieselguhr. Apply with a cloth, and, when dry, use another clean cloth, or a brush.

d.—Precipitated chalk, 30 parts: ammonia water, 30 parts; alcohol, 45 parts; water, 200 parts. For polishing silver and other metals.

e.—Dried sodium carbonate, 1 part; soap, 4 parts; flour of emery, 25 parts; water, enough to make a paste.

f.—Prepared chalk, 8 oz.; oil of turpentine, 2 oz.; alcohol, 1 oz.; water of ammonia, 2 dr.

g.—Peroxide of iron (jewelers' rouge) 20 parts; rotten stone, 20 parts; infusorial earth, 20 parts; oxalic acid, 1 part; palm oil, sufficient; vaseline, sufficient; oil of mirbane, sufficient to perfume. Pulverize, and mix, so proportioning the palm oil and vaseline that you have a liquid sufficiently "thick" to hold the powders in suspension.

h.—Naphtha.—(1) A mixture of equal parts of sperm oil, paraffine oil and naphtha is said to make a good cleaner for metals, and is a lubricant as well.

(2) Venice tripoli, 1 lb.; Spanish whitting, 1 lb.; powdered pumice, 8 oz.; kerosene, 3 oz.; crude oleic acid, 3 oz.; crude petroleum jelly to make a paste. Naphtha might be used in place of the kerosene. When naphtha or benzine is used there is always more or less danger from fire. They evaporate rapidly on exposure to the air, and unless the polish containing them is used at once, or is kept in a tightly closed container, they will probably be entirely lost.

i.—Star Metal Polish.—Powdered tripoil, 3 oz.; tartaric acid, 1 dr.; powdered pumice, ½ oz.; gasoline, 14 fl.oz. Shake well, and apply with a woolen cloth until the dirt is removed; then polish with chamois.

j.—Tripoli, 9 kgm.; infusorial earth, 9 kgm.; Japanese wax, 5 kgm.; olein, 12 kgm.; benzine, 90 kgm.

k.—Fulmenol—Chalk, 100 kgm.; olein, 64 kgm.; ammonia water, 38 kgm.; alcohol, denatured, 49 kgm.; benzine, 49 kgm.

l.—Rotten stone, 16 av.oz.; paraffine, 8 av.oz.; kerosene (coal oil), 16 fl.oz.; oil of mirbane, enough to perfume. Melt the paraffine, incorporate the rotten stone, add the kerosene and the oil of mirbane when cold.

m.—Oxalic acid, ½ av.oz.; rotten stone, 10 av.oz.; kerosene (coal oil), 30 fl.oz.; paraffine, 2 av.oz. Pulverize the oxalic acid, and mix it with the rotten stone; melt the paraffine, add to it the kerosene, and incorporate the powder; when cool, add oil of mirbane or lavender, to perfume.

n.—Pumice, 2 av.oz.; rotten stone, 2 av.oz.; iron carbonate, 2 av.oz.; paraffine, 2 av.oz.; gasoline, 16 fl.oz. Mix the pumice, rotten stone and iron; pass through a fine sieve to remove all grit; melt the paraffine, and pour into the gasoline; to this solution now add the powder, with shaking, to thoroughly incorporate the same.

o.—Levigated rotten stone, 2 oz.; iron subcarbonate, 6 oz.; oil of mirbane, enough to flavor; oleic acid or cotton-seed oil, sufficient to bring the mixture to the right consistency.

p.—Rotten stone, 8 oz.; oxalic acid, 2 oz.; cotton-seed oil, 3 oz.; benzine, enough to bring the mixture to the consistency desired.

q.—Bohemian tripoli powder, 1 lb.; Spanish whiting, 1 lb.; commercial red oxide of iron, ½ lb.; common petroline, burning oil, 1 oz.; glycerine, q. s.; water,

q. s.; oil of citronella, ½ oz. Thoroughly mix the powders, then add the petroline, etc.

r.—Meyer's Putz Cream.—Oleine, white, 10 kgm.; stearine, 5 kgm.; kieselguhr, extra white, elutriated, 20 kgm.; turpentine oil, 20 kgm.; benzine or petroleum (high boiling), 25 kgm.; spirit, 96%, 5 kgm.; spirit of sal ammoniac, 0.960 sp. gr., 6 kgm.; water, 5 kgm. All polishing agents may be perfumed with mirbane oil, amylacetate, ordinary lavender oil or safrol.

6.—*Pastes and Pomades.*—a.—Melt 5 lb. of lard or yellow vaseline, and mix with 1 lb. of fine rouge.

b.—Melt together 2 lb. of palm oil and 2 lb. of vaseline, and stir in 1 lb. of rouge, ½ lb. of tripoli and 1 oz. of oxalic acid.

c.—Buff Color.—Petroleum jelly, 42 lb.; refined paraffine wax, 14 lb.; powdered bath brick, 14 lb.; powdered pineclay, 14 lb.; powdered pumice, 2 lb.; yellow ocher, 2 lb.; oleic acid, 1 lb.; oil of cassia, 3 oz. Melt the wax and jelly, stir in the others, and grind as before.

d.—Putz Pomades.—The *Journal der Goldschmiedekunste* gives the first 3 formulae following for polishing pomades:

(1) Anhydrous sodium carbonate, 5 parts; tallow soap, 20 parts; levigated emery, 100 parts; water, 100 parts. Mix, put on the water bath, and heat, under constant agitation, until a smooth, homogeneous paste has been obtained.

(2) Jewelers' rouge, 1 part; petrolatum, 1 part; oil of mirbane, q. s. to perfume. Mix intimately.

(3) Oil of turpentine, 1 part; levigated emery, finest, 1 part; jewelers' rouge, 2 parts; petrolatum, 2 parts; oil of mirbane, q. s. Rub up together to a homogeneous pomade.

(4) Rotten stone, 1 part; iron subcarbonate, 3 parts; lard oil, enough.

(5) Iron oxide, 10 parts; pumice stone, 32 parts; oleic acid, enough.

(6) Soap, cut fine, 16 parts; precipitated chalk, 2 parts; jewelers' rouge, 1 part; cream of tartar, 1 part; water, enough. Dissolve the soap in the smallest quantity of water over a water bath; add the other ingredients to the solution while still hot, stirring all the time, to make sure of complete homogeneity; pour the mass into a box with shallow sides, and afterward cut into cubes.

(7) Petrolatum, 42 parts; refined paraffine, 14 parts; powdered bath brick 14 parts; powdered pipeclay, 14 parts; powdered pumice, 2 parts; oleic acid, 1 part.

(8) Dried sodium carbonate, 5 parts; soap, 20 parts; levigated emery, 100 parts; water, 100 parts. Mix, put on a water bath, and heat, under constant agitation, until a smooth, homogeneous paste has been obtained.

(9) Emery flour, 50 parts; jewelers' rouge, 50 parts; mutton suet, 40 parts; oleic acid, 40 parts. Melt the suet and oleic acid together over a water bath, and when thoroughly mixed remove from the fire; when cooled, but still soft, add the powders, and rub until they are evenly distributed throughout the mass.

(10) Ferric oxide, 8 oz.; paraffine, 2 oz.; lubricating oil, 6 oz.; oleic acid, 1 oz. Melt the paraffine with the lubricating oil and mix with the ferric oxide, previously well levigated; then add the oleic acid.

(11) Mix equal parts of jewelers' rouge and petrolatum.

(12) Stearine, 8 to 9 parts; mutton suet, 32 to 38 parts; neatsfoot oil, 2 to 2.5 parts; jewelers' rouge, finest levigated, 20 parts; levigated calcium carbonate, 40 to 60 parts. Melt the suet, stearine and oil together.

(13) Quartz sand, powdered and levigated, 20 parts; jewelers' rouge, finest levigated, 30 parts; vaseline, 50 parts. Mix. Instead of quartz sand, levigated infusorial earth may be used.

e.—Dehydrated soda, 5 parts; curd soap, 20 parts; emery flour, 100 parts. To be stirred together in a water bath, with 100 parts of water, until of soft consistency.

f.—Turpentine, 1 part; emery flour, 1 part; Paris red, 2 parts; vaseline, 2 parts. Mix well, and perfume.

g.—Stearine, 8 to 9 parts; mutton suet, 32 to 38 parts; stearine oil, 2 to 2.5 parts. Melt together, and mix with Vienna chalk, in fine powder, 48 to 60 parts; Paris red, 20 parts.

h.—Red Polishing Paste, Acid.—Rotten stone, 30 lb.; bath brick, powder, 28 lb.; red ocher, 26 lb.; emery flour, 14 lb.; crocus martis, 14 lb.; oxalic acid, 10½ lb.; petroleum jelly, 50 lb.; mineral oil, 1¼ gal.; citronella oil, 6 oz. Powder the oxalic acid, and mix with the earthy matters by running through sieves; then grind up with the greases. Some bases absorb more oil than others, and if the paste is rather stiff add more oil or jelly. The correct consistency for metal paste should be that of butter in winter. If softer, it will ooze out during the hot weather, but will not become so soft as butter does, as the earthy matters keep in the grease to a large extent.

i.—Red Polished Paste, Without Acid, —A. C. peroxide (sesquioxide of iron), 40 lb.; Venetian red, dry, 36 lb.; palm oil, 20 lb.; petroleum jelly, 20 lb.; mineral lubricating oil, ½ gal.; mirbane oil, 4 oz. Melt the palm oil, mineral oil and jelly; stir in the peroxide and red, add scent, then grind. Some pastes are not ground, but simply mixed together, causing them to sweat when tinned; moreover, they do not look so well as those put through the mill.

j.—Sharp Polishes.—The following may be used on dirty brasses, copper articles, etc.: (1) Quartz sand, powdered and levigated, 20 parts; Paris red, 30 parts; vaseline, 50 parts. Mix intimately and make a pomade. (2) Emery flour, finest levigated, 50 parts; Paris red, 50 parts; mutton suet, 40 parts; oleic acid, 40 parts. Mix.

k.—White Paste.—(1) Tallow, 36 lb.; white mineral jelly, 20 lb.; non-gritty chalk, 30 lb.; levigated flint, 4 lb.; powdered pumice, 3 lb.; oxalic acid, 2½ lb. Melt the tallow and jelly, powder the acid, mix well with the pumice, flint and chalk; mix all, and grind.

(2) White petroleum jelly, 90 lb.; kieselguhr, 30 lb.; refined paraffine wax, 10 lb.; refined chalk or whiting, 10 lb.; soda hyposulphite, 8 lb. Melt wax and jelly, stir in others, and grind. It is an undecided point as to whether a scented paste is better than one without perfume. The latter is added merely to hide the nasty smell of some of the greases used, and it is not very nice to have spoons, etc., smelling, even tasting, of mirbane, so perhaps citronella is best for this purpose. It is likely to be more pure. The does of scent is usually at the rate of 4 oz. to the cwt.

7.—*Powders.*—a.—Kieselguhr, 80 parts; tin oxide, 30 parts; pipeclay, 30 parts; tartaric acid, 3 parts.

b.—Kieselguhr, 28 parts; pipeclay, 10 parts; sodium hyposulphite, 3 parts; ferric oxide, 2 parts.

c.—Chalk, 10 av.oz.; white bole, 4 av.oz.; lead carbonate, 5 av.oz.; magnesium carbonate, 1 av.oz.; iron oxide, 1 av.oz. This mixture is best adapted to brass and copper.

d.—Calcined magnesia, 8 av.oz.; jewelers' rouge, 8 av.oz. This mixture is recommended for polishing gold; it should be used dry.

e.—Magnesium carbonate, 4 av.oz.; chalk, 4 av.oz.; jewelers' rouge, 7 av.oz.

f.—Palm oil, 16 av.oz.; petrolatum, 16 av.oz.; jewelers' rouge, 8 av.oz.; tripoli, 7 av.oz.; oxalic acid, 160 gr.

g.—Hard Metals.—*Science, Arts and Nature* gives the following: Infusorial earth, 80 parts; tin oxide, 30 parts; pipeclay, 30 parts; tartaric acid, 3 parts. Powder and mix.

h.—Kieselguhr, 28 parts; pipeclay, 10 parts; sodium hyposulphite, 3 parts; ferric oxide, 2 parts.

i.—Kieselguhr, 42 lb.; putty powder, 14 lb.; pipeclay, 14 lb.; tartaric acid, 1½ lb. Powder the acid, mix well with the others. This is styled "free from mercury, poisonous mineral acids, alkalies, or grit." It may be tinted with 12 oz. of oxide of iron, if desired.

j.—Kieselguhr, 28 lb.; powdered pipeclay, 10½ lb.; flake white, 7 lb.; soda hyposulphite, 3 lb.; iron oxide, 2 lb. Finely powder, and mix well.

k.—Carbonate magnesia, 5 lb.; calcium carbonate, 5 lb.; ferric oxide, 8¾ lb.; mix thoroughly.

l.—Carbonate of magnesia, 5 lb.; elutriated colcothar, 6 oz. 7 dr.

m.—A very useful polishing powder for metals and glass is made of very finely ground glass mixed with a small proportion of dried soda ash.

8.—*Preserving the Polish on Bright Surfaces.*—a.—Take 2¼ oz. of rosin and from 15 to 20 oz. of lard; melt slowly together, stirring until cool. The mixture is used when semi-fluid. It may be thinned by coal oil or benzine. Put on a bright surface, even thinly, it will preserve the polish, and it can be readily rubbed off.

b.—Gutta percha, 8 lb.; mutton suet, 16 lb.; beef suet, 24 lb.; neatsfoot oil, 1½ gal.; rape oil, ¾ gal. Melt and dissolve thoroughly; color with a little rose pink; add oil of thyme or other perfume. When cold, rub on the surface of bright steel, iron, brass, or other metal requiring protection from rust.

9.—*Soaps.*—a.—Liquid curd soap, 20 to 25 lb., intimately mixed with about 30 lb. of fine chalk and ½ lb. of Venetian red.

b.—Liquid cocoanut-oil soap, 26 lb., mixed with 12 lb. of tripoli and 1 lb. each of alum, tartaric acid and white lead.

c.—Melted cocoanut oil, 25 lb., saponified with 12 lb. of soda lye of 38 to 40° B., after which 3 lb. of rouge, 3 lb. of water and 2 oz. of ammonia are crutched in.

d.—Powdered pipeclay, 112 lb.; tallow soap, 16 lb.; tartaric acid, 1¼ lb. Grind until pasty; afterward press into blocks by the machine.

e.—Levigated flint, 60 lb.; whiting, 52 lb.; tallow, 20 lb.; caustic soda, 5 lb.; water, 2 gal. Dissolve the soda in the water and add to the tallow; when saponified, stir in the others, pressing as before.

f.—Saponified cocoanut oil, 56 lb.; kieselguhr, 12 lb.; alum, 5½ lb.; flake white, 5½ lb.; tartaric acid, 1¾ lb. Make as before.

g.—Tallow soap, 98 lb.; liquid glycerine soap, 14 lb.; whiting, 18 lb.; levigated flint, 14 lb.; powdered pipeclay, 14 lb.

h.—Stir into 37½ lb. of liquid cocoanut-oil soap 3 lb. of tripoli and 1½ lb. each of alum, tartaric acid and white lead.

i.—Cocoanut oil, 40 lb., stirred into 20 lb. of lye of 38 to 40°. When the mixture is bright add 5 lb. of colcothar mixed with 5 lb. of water. Put in finally 2 oz. 1 dr. of spirit of sal ammoniac.

j.—Shave finely 11 lb. of cocoanut soap, add some water, and melt; add 13 oz. 2 dr. of chalk, 6 oz. 4 dr. each of alum, tartaric acid and white lead; stir vigorously.

k.—Hard Polishing Soap.—Cocoanut oil, 10 lb.; solution of soda 23°, enough; tripoli powder, 2 lb.; alum, 1 lb.; cream of tartar, 1 lb.; whiting, 1 lb. Set the oil with a sufficient quantity of the soda solution, and boil the mixture until it is ready to form jelly. When this soap has sufficiently solidified, stir in the other ingredients, all previously reduced to the finest powder, and intimately mixed. Pour the mixture into suitable molds and allow it to harden.

l.—Pink Tablets.—XX pale soap, 112 lb.; powdered pipeclay, 40 lb.; soda hyposulphite, 6 lb.; rose pink, 4 lb. Grind and press as before. Another way of coloring is to add a little peroxide of iron, or make a solution of aniline in water. The rose pink should be pure wood color; if the color has been given to it by anilines, these may fade or change.

m.—Soft Polishing Soap.—Colcothar, 8 oz.; ammonium carbonate, 5½ oz.; cocoa soap, 6½ lb.; water enough. Wash the colcothar (which is the dark-red iron peroxide known to painters as Indian red) 6 or 8 times in water, and dry it. Dissolve the soap in sufficient water to make a viscid liquid. Reduce the ammonium carbonate to a fine powder and rub it and the colcothar into a paste with a little water. Gradually add the soap solution, stirring constantly. Keep the product in stone jars, well covered.

10.—*Tube Polish.*—A new form of polisher is put up in cylindrical cardboard "push-up" cases, like cosmetique. These tubes are quite inexpensive, and they would have only to be filled with the composition and labeled, when they would be ready for sale. Tallow, 10 lb.; lard, 10 lb.; Japan wax, 10 lb.; iron oxide, 8 lb.; soda hyposulphite, 1 lb. Melt the first three and stir in the other two, mixed together beforehand. This is of a red color.

Mildew. (See also **Lace**).

1.—Hypochlorite of alumina is said to be one of the best remedies. Moisten with water, rub well into the cloth, coisten again with dilute sulphuric acid (1 to 20), and after half an hour rinse thoroughly in soft water and then in water containing about 1 oz. to the gallon of sulphite or hyposulphite of soda. A stiff brush may be advantageously employed in applying the hypochlorite.

2.—*Cotton Goods.*—a.—If the goods are colored, soak for 24 hours or more in sour milk or buttermilk, then rinse in water, and wash in strong soapsuds. If the goods are white, moisten the spots repeatedly with Javelle water diluted with volumes of water; rinse well, then wash in strong soapsuds, not too hot.

b.—Well mix together 1 spoonful of table salt, 2 spoonfuls of soft soap, 2 spoonfuls of powdered starch, and the juice of a lemon. Lay this mixture on both sides of the stain with a painter's brush, and then lay the article on the grass, day and night, until the stain disappears.

3.—*Linen.*—a.—Take soap, and rub it well; then scrape some fine chalk, and rub that also in the linen; lay it on the grass; as it dries, wet it a little, and the stain will come out at once.

b.—Two tablespoonfuls of soft soap and the juice of a lemon. Lay it on the spots with a brush, on both sides of the linen. Let it lie a day or two till the stains disappear.

c.—Wash clean, and take every particle of soap off; then put the linen into a galvanized bath or tub full of clean cold water; procure a little chloride of lime, and tie it up in a muslin bag or piece of muslin, dissolve the lime in lukewarm water by squeezing the bag, then pour the water among the clothes. Stir, and leave them for 24 hours, but do not put too much lime in, or you will rot the clothes; then well rinse in clean, cold water.

4.—*Prevention.*—Housekeepers are often greatly troubled and perplexed by mildew from damp closets and from rust. By putting an earthen bowl or deep plate, full of quicklime, into the closet, the lime will absorb the dampness and also sweeten and disinfect the place. Rats, mice, and many bugs that are apt to congregate in damp places have a dislike to lime. As often as the lime becomes slaked throw it on the compost heap, if in the country, or into the ash barrel, if in the city.

5.—*Silk.*—Get a piece of flannel, dip it into whisky, and well rub the place marked; then iron on the wrong side, taking care to put a piece of damp cotton cloth between the iron and the silk, and iron on the cotton cloth, which will prevent the silk assuming a shiny, glazed appearance.

Nickel.

1.—To clean nickelplated objects, dip them for a second or two in a 2% solution of sulphuric acid, rinse in running water, and finally with a .mixture, in equal parts, of distilled water and alcohol. Dry in sawdust.

2.—*Polish.*—a.—Ordinary rouge is used by nickelplaters as a polish.

b.—Another preparation, said to be an excellent one, is made by mixing ½ oz. of quicksilver and 2 oz. of chalk. To use, add a small quantity of alcohol, and polish with a chamois skin. These polishes do not restore the plating, however, and if the nickeling be worn off, the only thing to do is to have the articles replated.

c.—Use chalk mixed with tallow.

d.—Equal parts of precipitated iron carbonate and prepared chalk, or take quicksilver with chalk, ½ oz., and prepared chalk, 2 oz., and mix them. When used, add a small quantity of alcohol, and rub with chamois leather.

e.—Rouge with a little fresh lard or lard oil, on a wash leather or piece of buckskin. Rub the bright parts, using as little of the rouge and oil as possible; wipe off with a clean rag slightly oiled. Repeat the wiping every day, and polishing as often as necessary.

3.—*Rust, Protection.*—In putting away a bicycle for the winter, every part should be thoroughly cleaned from dirt, the running parts duly oiled, and the bright parts wiped with a mixture of vaseline and paraffine (2 parts of vaseline to ½ part of paraffine), to which add ½ pt. of finely ground quicklime by heating and stirring; apply warm, by wiping all the nickel parts, and wrapping them in paper which has been coated on one side by the mixture, very thin, which will keep off rust and dampness. The japanned parts and saddle should also be nicely covered with wrapping paper to keep off dust, which injuries the japan by long contact.

4.—*Rust Removal.*—First cover the objects with grease, and in 3 or 4 days rub them with a rag soaked in ammonia. This will dissolve the rust without attacking the nickel. If the rust resists this treatment, apply a little chlorhydric acid, and immediately afterward rub with a cloth, so that the nickeling may not be affected. Then wash, dry well, and polish.

Nitric Acid Stains.

These yellow stains can be removed either from the skin or from brown or black woolen garments by moistening the spots for a while with permanganate of potash and rinsing with water. A brownish stain of manganese remains, which may be removed from the skin by washing with an aqueous solution of sulphurous acid. If the spots are old, they cannot be entirely removed.

Oil Stains.

Immerse the goods in a soap bath, which should be kept at nearly a boiling temperature. If the stains are fresh, smear them with tallow or lard, and afterward rub the goods with soap in cold water. Benzine or turpentine is also sometimes successfully used in removing oil stains.

Oils and Fats, Bleaching.

1.—Many plans of decolorizing oils are in vogue: Exposure to sunlight in large white glass bottles; the oil soon becomes colorless, but acquires an almost rancid flavor.

2.—Agitation, with 2% of a solution of permanganate of potash, bleaches effectually, but also leaves a bad flavor.

3.—The oil is first agitated with water containing gum, and to the emulsion thus formed is added coarsely crushed wood charcoal; the whole is then slowly warmed to a degree not reaching 212° F. (100° C.), and when cold the oil is dissolved out by ether or petroleum spirit, and the latter is recovered by distillation; the result is good.

Opals, To Restore the Polish.

By rubbing with oxide of tin or putty powder on a piece of chamois skin, wet; finish with refined chalk, also on chamois skin, wet, then wash the opal with a soft brush and water. With a little care this may be done without taking it from the setting.

Paint.

1.—*Brushes and Vessels.* — a. — The cleaning of the brushes and vessels in which the varnish or oil paint has dried is usually done by boiling with a soda solution. This frequently spoils the brushes or cracks the vessels, if of glass; besides, the process is rather slow and dirty. A much more suitable remedy is amyl acetate, which is a liquid with a pleasant odor of fruit drops, used mainly for dissolving and cementing celluloid. If amyl acetate is poured over a resinified oil-paint brush, the varnish dissolves almost immediately, and though ever so hard and dry, the brush is again rendered serviceable at once. If necessary, the process is repeated. For cleaning vessels shake the liquid about in them, which softens the paint so that it can be readily removed with paper. In this manner much labor can be saved. The amyl acetate can be easily removed from the brushes, etc., by alcohol, oil of turpentine or varnish. Most agents for removing varnish and oil from paint coatings owe their efficacy to the presence of caustic alkalies. But since the latter exercise a destructive action upon bodies of organic origin, the preparations containing caustic alkalies can only be employed to a limited extent, and with the greatest care. They do not only have a decomposing influence upon the wood fiber, but their use is also quite dangerous, owing to their strong caustic effect upon the human skin. It has been found that the unpleasant by-effects of the caustic alkali can be completely obviated, while the dissolving power for the dry varnish and oil-paint layer is yet materially increased, if a mineral oil is emulsified in the solution of the caustic alkalies. In order to maintain the oil lastingly in emulsion, the easily mobile mass is mixed with a sufficient quantity of an indifferent body, such as brickdust, powdered pumice stone, sawdust, etc; thus a form highly suitable for application, as that of a paste, is obtained. This paste constitutes a very efficacious and durable paint remover, which may be applied moist on any surface, and exercises no deleterious action upon the fibers of the wood and the human skin. For producing the new paint remover proceed as follows; Dissolve 20 kgm. of caustic soda (98%) in 100 l. of water, mix the solution with 20 kgm. of mineral oil, and stir, in a kettle provided with a mechanical stirrer, until the emulsion is complete. Now add with stirring, 20 kgm. of sawdust, and pass the whole through a paint mill to obtain a uniform intermixture.

b.—When a paint brush is stiff and hard through drying with paint on it, put some turpentine in a shallow dish and set on fire. Let it burn for a minute, until hot, then smother the flames and work the pencil in the fingers, dipping it frequently into the hot spirits. Rinse all paint brushes, pencils, etc., in turpentine, grease with a mixture of sweet oil and tallow, to prevent them from drying hard, and put them away in a close box.

c.—To soften brushes that have become hard, soak them 24 hours in raw linseed oil and rinse them out in hot turpentine, repeating the process till clean; or wash them in hot soda and water and soft soap.

2.—*Clothing: Paint, Varnish and Rosin Stains.*—a.—For white or colored cotton and woolen goods, oil of turpentine or benzine, followed by soapsuds. For silk, benzine, ether, soap; hard rubbing is to be avoided. For all kinds of fabrics chloroform is best, but must be carefully used.

b.—Stains of paint or varnish, after being softened with olive oil or fresh butter, may generally be removed by the same means as ordinary grease spots.

c.—Saturate the spots with a solution of equal parts of turpentine and spirits of ammonia; wash out with strong soapsuds.

d.—Paint stains that are dry and old may be removed from cotton or woolen goods with chloroform. First cover the spot with olive oil or butter.

e.—Professor Snellal recommends an emulsion of 2 parts of ammonia with 1 part of turpentine; moisten a rag with the solution and rub the spot well.

3.—*Dissolving and Removing Coatings of Paint, Varnish and Lacquer.*—a.—A firm of English manufacturers have discovered that certain vegetable fatty acids have the property of softening and removing hardened paints and varnish, reports the *Chemist and Druggist,* and that this property is greatly increased in cooperation with the solvent properties of already well-known solvents. It is mixed in various ways: Arachic acid, 18 parts; benzine, 42 parts; methyl alcohol, 40 parts.

b.—Palmitic acid (vegetable), 25 parts; benzine, 35 parts; amyl aceate, 40 parts. The solutions are applied with a brush in the ordinary way.

c.—Scraping or burning paint off is extremely laborious and too slow for general purposes. A more thorough and expeditious way is by chemical process, using for that purpose a solution of soda and quicklime in equal proportions. The solution may be made as follows: The soda is dissolved in water, the lime is then added, and the solution is applied with a brush to the old paint. A few moments are sufficient to remove the coats of paint, which may be washed off with hot water. The oldest paint may be removed by a paste of the soda and quicklime. The wood should be afterward washed with vinegar or an acid solution before repainting, to remove all traces of the alkali.

d.—Wet the place with naphtha, repeating as often as is required; but frequently, one application will dissolve the paint. As soon as it is softened, rub the surface clean. Chloroform, mixed with a small quantity of spirit ammonia, composed of strong ammoniac, has been employed very successfully to remove the stains of dry paint from wood, silk, and other substances.

e..—Acetone, 3 oz.;; fusel oil, 3 oz.; wood alcohol, 6 oz.; gasoline, 4 oz.; carbon bisulphide, 2 oz. Mix.

f.—Caustic soda (98%), 1 lb.; starch, 2 oz.; china clay, 2 oz.; warm water, 2 lb.; cold water, 2 lb. Dissolve the soda in the warm water, and stir the starch and clay well together, adding the cold water, a little at a time, until all is used. When the soda solution gets cold add it to the other mixture and stir to a smooth paste. This is used by applying to the paint and allowing it to remain for a few minutes, when paste and paint may be removed with a scraper or old brush. The wood should then be washed with clean water, and if that does not remove the soapy feel (or taste), another washing with water and vinegar should be given.

g.—A Eberson in *Revue des Prodits Chimiques*, gives the following process for the complete removal, without injury to the surface to which they are applied, of old, hard paint, varnish, etc.: Make a mixture of alcohol, 55 parts; benzol, 20 parts; carbon bisulphide, 25 parts; wax, 5 parts. This makes a sticky mass, that is applied to the surface of the paint or varnish, and soon softens the latter in such a manner that it may be scratched or scraped off. The amount of wax employed depends on the desired consistency of the mixture, and is added only to prevent the too rapid evaporation of the carbon bisulphide and benzol. The alcohol may be supplanted by 30 parts of wood spirit (methyl alcohol) and 25 parts of acetone. The wax is first dissolved in a mixture of the carbon bisulphide, benzol and acetone, and the alcohol is added to the solution. A similar mode of proceeding should be followed in the first instance, dissolving the wax in the benzol and carbon bisulphide, and adding the alcohol afterward. Instead of wax, paraffine or ceresine may be employed as a preventive of evaporation. The operation of softening is accelerated by the addition of oil or fats.

4.—*Woodwork, Walls, etc.* — a. — To clean paint, provide a plate with some of the best whiting to be had; have ready some clean warm water and a piece of flannel, which dip into the water and squeeze nearly dry; then take as much whiting as will adhere to it, and apply it to the painted surface, when a little rubbing will instantly remove any dirt or grease. After which wash the part well with clean water, rubbing it dry with a soft chamois. Paint thus cleaned looks as well as when first laid on, without any injury to the most delicate colors. It is far better than using soap, and does not require more than half the time and labor.

b.—To clean paint, take 1 oz. of pulverized borax, 1 lb., small pieces, of best brown soap, and 3 qt. of water; let simmer till the soap is dissolved, stirring frequently. Do not let it boil. Use with a piece of old flannel, and rinse off as soon as the paint is clean. This mixture is also good for washing clothes.

c.—Dissolve ½ oz. of glue and a bit of soft soap the size of a walnut in about 3 pt. of warm water, and with a well-worn whitewash brush well scrub the work, but not sufficient to get off the paint, and rinse with plenty of cold, clean water, using a wash leather; let dry itself. Work done in this manner will often look equal to new.

d.—First take off all the dust with a soft brush and a pair of bellows. Scour with a mixture of soft soap and fuller's earth, and use lukewarm water. If there are any spots which are extra dirty, first remove these by rubbing with a sponge dipped in soap and water. Commence the scouring at the top of the door or wainscot, and proceed downward, and dry with a soft linen cloth. When cleaning paint, it is always better to employ two persons, one to scour and the other to rub dry.

e.—The specifications of an English patent call for lemons, or other acid fruit, 2 lb.; hydrochloric acid, 1 lb.; water, 4 lb. These are mixed, boiled to a thick paste, and incorporated with oxalic acid, 2 lb., and black treacle, 3 lb. When cold, butyric acid, 1 fl.oz., or other grease-dissolving acid, is stirred in, and the whole made up to 1 gal. with water. The composition is applied to the painted, varnished or polished surface, left for a sufficient time, and then washed off.

f.—The following receipt is designed for painted objects that are much soiled. Simmer gently on the fire, stirring constantly, 30 grams of pulverized borax and 450 grams of brown soap of good quality, cut in small pieces, in 3 l. of water. The liquid is applied by means of flannel, and rinsed off at once with pure water.

g.—When painted work is badly discolored, put a tablespoonful of ammonia water into 1 qt. of moderately hot water, and with the aid of flannel wipe off the surface. Rubbing is not necessary. When the discoloration is not great, the following method is preferable: With a piece of clean flannel wet with clean warm water, and then squeezed nearly dry, take up as much whiting, of the best quality, as will adhere, apply this, with moderate rubbing, to the painted work, and afterward wash the surface with clean water and rub it dry with chamois leather. This method is superior to the use of soap, requires but half the time and labor, and leaves the surface cleaned, looking as good as new. It will not injure the delicate colors.

Paintings.

To clean an oil painting, take it out of its frame, lays a piece of cloth, moistened with rain water, on it, and leave it for a while to take up the dirt from the picture. Several applications may be required to secure a perfect result. Then wipe the picture very gently with a tuft of cotton wool damped with absolutely pure linseed oil. Gold frame may be claned with a freshly cut onion; it should be wiped with a soft sponge wetted with rain water, a few hours after the application of the onion, and must finally be wiped with a soft rag. Valuable paintings should be taken to an expert, as cleaning and restoring requires special knowledge, and damage is likely to result from inexperienced handling.

Panama Hats, Bleaching and Cleaning.

1.—To bleach Panama hats, wash the goods clean, and, while slightly damp, expose to the fumes of burning sulphur in a closed vessel. To color 1 doz. hats, take 12 lb. of logwood, 1 lb. sulphate of iron and ¾ lb. of verdigris. Digest the logwood for some time. Add the sulphate of iron and verdigris. Dip the hats in the bath several times and hang in the open air. By the peroxidizement of the iron with the atmospheric oxygen the hats will be more completely blackened. When fully dried wash in running water.

2.—To clean a Panama hat which has become stained by perspiration, the *National Druggist* recommends the following process: Apply first sodium hypophosphite, in a strong solution, liberally. The best plan is to immerse the hat in the solution, and shortly afterward immerse it in one of oxalic acid. After the stain has disappeared, which it will do in the course of an hour or two, rinse the hat in clear water first, and afterward in water carrying a little glycerine. Then let it dry, and send it to the hatter to be blocked. The object of the second rinsing is simply to make the hat supple.

3.—Subject to a good scrubbing with Castile soap and warm water; use a nail brush to get the dirt away. Place in the hot sun to dry, and in the course of 2 or 3 hours it will be ready for use. A little glycerine added to the rinsing water entirely prevents the stiffness and brittleness acquired by some hats in drying, while a little ammonia in the wash water materially assists in the scrubbing process. Ivory, or, in fact, any good white soap, will answer as well as Castile. It is well to rinse a second time, adding the glycerine to the water used the second time. Immerse the hat completely in the rinse water, moving it about to get rid of traces of the dirty water. When the hat has been thoroughly rinsed, press out the surplus water, using a Turkish bath towel for the purpose, and let it rest on the towel when drying.

Paper.

1.—*Grease Spots from Printed Paper or Manuscipt, Lithogaphs, Copper Engravings, etc.*—a.—Place the soiled sheet inside a book, if it is not already bound in a hook. Then sprinkle the spot uniformly on both sides with finely sifted, warmed white bole, half a line thick, put the book in a press, or weight it down with stones. In 24 hours clean the spot carefully and sprinkle it again with fresh, warm bole, which must likewise be left for 24 hours in contact with the spot. The latter will then have entirely disappeared. A thick paste prepared from burnt magnesia or white bole, with benzol or benzine, is also very useful for removing grease spots from paper or clothes. It is applied to the spot, and, when dry, brushed and scraped off, after which no trace of the spot will be found.

b.—Benzol-magnesia is an excellent medium for the removal of grease spots from paper. Calcined magnesia is mixed with sufficient pure benzol until a mass is obtained that is, after some time, friable. A little of this substance is carefully rubbed with the finger on the grease spot and the small crumbs of magnesia shaken off. Fresh spots usually disappear at once, older ones after a short time, especially if the benzol-magnesia is applied 3 or 4 times and then shaken off. The benzol-magnesia must be kept in glass bottles with well-ground-in glass stoppers.

c.—Press powdered fuller's earth lightly upon the greasy spot and allow it to soak out the grease.

d.—Hannett says the spots may be removed by washing the part with ether, chloroform or benzine, and placing between white blotting paper, then passing a hot iron over.

e—A more expeditious, and thought by some the best way, is to scrape fine pipeclay, magnesia or French chalk on both sides of the stain, and apply a hot iron above, taking great care that it is not too hot.

f.—After gently warming the paper, take out all the grease you can with blotting paper and a hot iron, then dip a brush into essential oil of turpentine, heated almost to ebullition, and draw it gently over both sides of the paper, which must be kept warm. Repeat the operation until all is removed, or as often as the thickness of the paper may render necessary. When all the grease is removed, to restore the paper to its former whiteness dip another brush in ether, chloroform or benzine, and apply over the stain, especially the edges of it. This will not affect printers' or common writing ink.

g.—Lay on a coat of India-rubber solution over the spot and leave it to dry. Afterward remove with a piece of ordinary india-rubber. Any operation with ether, chloroform or benzine should never be conducted by candle light, as their vapor is apt to kindle even at several feet from the liquid. The recipe "e" will remove grease from colored calf. Even if the spot be on the under side of the leather, it may thus be clearly drawn right through.

h.—Apply a solution of pearlash (in the proportion of 1 oz. of pearlash to 1 pt. of water) to oil-stained drawing paper.

2.—*Iodine Stains.*—Apply a solution of pure sodium hyposulphite and then strong ammonia water, by means of blotting paper; remove excess by pressing between sheets of bibulous paper moistened with water, and dry between clean, warm (dry) blotting pads. Iodine stains may also be removed by alcohol.

3.—*Mildew Stains.*—Soak 1 oz. of gelatine for some hours in 1 pt. of water, and 1 oz. of white soap scraped in the same quantity of water; mix the two solutions, and boil till dissolved. Dissolved 1 dr of alum in 2 oz. of water, and add it to the above. When the mixture is cold decant the solution from all sediment. Spread the above over the damaged paper with a stout feather. If the paper be in a very bad state a second coat may be applied. A little spirits of wine added to the solution tends to keep it good..

4—*Oil Stains.*—Use pipeclay mixed with water. Allow it to remain on the spot for several hours.

Papier Mache.

1.—Linseed oil, ½ pt.; old ale, ½ pt; the white of 1 egg; spirits of wine, 1 oz.; hydrochloric acid, 1 oz.; well shake before using. A little to be applied to the face of soft linen pad and lightly rubbed for a minute or two over the article to be restored, which must afterward be polished off with an old silk handkerchief. This will keep any length of time if well corked Invaluable for delicate cabinet work.

2.—Wash with water, dredge wih flour, and polish with a dry flannel cloth.

3.—Rub thoroughly with a paste made of wheat flour and olive oil. Apply with a bit of soft flannel or old linen, rubbing quite strongly; wipe off, and polish by rubbing with an old silk handkerchief.

Paraffine.

The crude paraffine is filtered, and boiled for 2 hours with 5% of its weighs of sodium sulphide and sufficient water. It is allowed to cool, so that the mass swimming on the top may become compact, and be removed; it is then washed with river water, pressed, and afterward dissolved in 20% amyl alcohol, the paraffine being left as a pasty and pliable mass. It must remain for a time, and then be strongly pressed after filtering through bone black.

Parchment.

Cleansing. — 1. — Blood Stains from Parchment.—a.—Blood stains should have been removed in the process of manufacture, as in the finishing parchment they may not be amenable to any of the ordinary methods of treatment. In the manufacture of the finer classes of leather, such as calf for bookbinders, and various skins for glovemakers, also of parcment or vellum, after the unhairing process, and before dressing, the skins are subjected to a bath of dog's putrid dung mixed with tepid water. This mixture is said to remove all fat, grease, and other stains. Manufacturers have tried to find a substitute for this unpleasant mixture, but have not suceeded. It is thought that the bacteria created by the putrefaction has some special effect not to be otherwise obtained.

b.—The following may also be tried: Immerse the parchment in a solution of acetic acid and gently rub the stained parts, while wet, with lump pumice, on a flat board; then bleach with chloride of lime. This is said to render the parchment white enough for bookbinding purposes. The parchment may also be subjected to a bath of salt of lemon (equal parts of citric acid and cream of tartar). These acids may have on the parchment a hardening effect, which is, of course, detrimental, so caution must be observed in their use.

c.—Animal parchment, or vellum, as the heavier qualities are called, should always be carefully treated, as it is very liable to become stained. In the manufacture of parchment it is almost impossible to remove the natural blood stains, and when these are very apparent it is not unusual for the manufacturers to treat the skin with some whitening substance of a chalky nature to hide the blemishes. When the skin is damped with water this white substance is washed off, and the original stains appear. Should this happen, it will be advisable not to attempt to remove the stains, as this will only make matters worse. Possibly, however, the water or sponge used for damping may not have been clean, and surface stains may have been caused. In this case, make a weak solution of oxalic acid in water, and with a clean sponge go carefully over the entire skin. But first ascertain whether the colors or ink will be damaged by washing. To do this, with the tongue touch some part of the parchment having a large amount of color, lay a piece of white blotting paper over the damped portion, and rub it with the thumbnail; if, on being lifted, the blotting paper is found to be clean, the work may be washed. But if the color comes away on the blotting paper, the washing should not be proceeded with. In any case, great care must be taken; the work must not be rubbed with the sponge, but this is passed swiftly over the entire surface, taking care that one portion does not get more washing or damping than another.

2.—Grease Stains from Parchment.—Grease stains can be removed with benzine. Make a small pad of cotton wool, saturate it with the spirit, and rub quickly and lightly over the entire surface of the parchment. When it has dried off, the grease stains should have disappeared. If not, repeat the operation, and be careful not to rub hard, as this spoils the surface.

3.—Point Marks from Parchment.—Put some benzine on a piece of flannel and apply to the skins, taking up the paint as soon as it is soft, and not smearing it over the skin. Finish with a little soap and water; finally, rub the skin with glycerine.

4.—Tea Stains from Parchment.—Tea stains are very difficult to remove from parchment. Try oxalic acid, and if this fails, it would seem hopeless to try further. The parchment may be dyed one color; this would help to hide the stains. Make a weak solution of permanganate of potash and wash the leaves over carefully with a sponge. This will give a good brown color, not unlike the tea stain. When all the leaves have been treated on one side, and are dry, turn the book over and treat the other side in a similar manner. Parchment is a very troublesome material to wash, owing to the greasy nature of the surface, and also to its liability to cockle when drying. If each leaf could be pinned down to a board when applying the stain, and allowed to dry while still pinned down, the job would look better.

5.—To clean parchment, immerse in solution of acetic acid, and gently rub the stained parts, while wet, on a flat board, with lump pumice; then bleach it with chloride of lime. This process was recommended in the *English Mechanic*. It is not very successful, but it makes it white enough for bookbinding. It has, however, the objectionable qualities of not making the parchment flexible, and, when dried, it is as hard as a board, and it has no gloss like the virgin parchment. On no account must the parchment be washed in very hot water, or held before a fire, as it will shrivel up in a most provoking mahner.

Pearls, To Clean.

Soak them in hot water in which barn has been boiled with a little cream of tartar and alum, rubbing gently between the hands when the heat will admit of it. When the water is cold renew the application till any discoloration is removed, rinse in lukewarm water; lay them on white paper in a dark place to cool.

Petrolatum Stains from Clothing.

Petrolatum stains may be removed from clothing, it is claimed (*Merck's Report*), by means of the following solution: Powdered soap, 1 part; aniline, 1 part; water, 10 parts. The spots are moistened with the liquid, and, after 5 to 10 minutes, washed with clean water. If necessary, a second application is made.

Pewter Articles.

The cleaning of articles of this metal is accomplished with hot lye of wood ashes and fine sand. Pour the hot lye upon the tin, throw on sand, and rub with a hard woolen rag, hat felt, or whisk, until all particles of dirt have been dissolved. To polish pewter plates, it is well to have the turner make similar wooden forms fitting the plates, and to rub them clean this way. Next they are rinsed off with clean water and placed on a table with a clean linen cover, on which they are left to dry without being touched, otherwise spots will appear. This scouring is not necessary so often if the pewter is rubbed off with wheat bran after use and cleaned perfectly. New pewter is polished with a paste of whiting and brandy, of which a little is used, rubbing the dishes with it until the mass becomes dry.

Precious Stones.

Wet, precipitated sulphur, moistened with alcohol. A mixture of 1 part of washed flowers of sulphur and 2 parts of fine washed tripoli powder is also adapted for this purpose. The mixture, by means of a soft leather, is rubbed on the precious stones. Places that are not accessible by means of the chamois can be treated with a small brush, a second brush being employed to remove the dust. If the gems are set in silver the sulphur must be omitted.

Prints.

Cleansing.—1.—Age Stains from Prints.—Mere age stains can be removed from engravings by placing the latter in a shallow tray (a tea tray, for instance) containing water, and exposing them to the rays of the sun till bleached, when they should be allowed to dry naturally. When dry they can be ironed with a hot iron, over several folds of linen, to take out all creases, etc.

2.—Damp Stains from Prints.—Stains caused by damp, etc., are removed by the following method: Cover the engraving in a glazed earthenware tray with clean rain water till the paper is saturated; then pour off the water and substitute a solution of chloride of lime strained through muslin. The moment the stain disappears pour the solution away, and rinse the engraving in clean water. Then dry, and insure smoothness by stretching the paper.

3.—Grease Stains from Prints.—a.—To remove grease stains, lay a sheet of muslin in a tea tray, and on the sheet lay the engraving. Take the whole into the open air and with a soft wash-leather pad well sponge the yellow stain with petroleum spirit or spirit of wine. Do not in any case attempt to do this indoors, or near artificial light, as the spirits are highly inflammable When the stain has been removed lift the muslin and engraving together from the dish to a table and cover the face with blotting paper, placing over this a sheet of brown paper, and then a sheet of calico. This done, turn the whole over, remove the muslin back, replace with blotting paper, brown paper and calico, and submit the whole to gentle pressure until dry.

b.—Lay the engraving between several folds of clean blotting paper and pass a hot iron over it. Continually change the paper and repeat the ironing

4.—Ink Marks from Engravings.—Dissolve 3 oz. of washing soda in 20 oz. of water, and mix with a solution of chloride of lime, 2 oz. in 20 oz. of water; after mixing, filter. Now take 2 or 3 oz. of the above solution and 10 oz. of water, and soak the engraving in it for about 15 minutes; remove, and soak in dilute hydrochloric acid (1 part of acid to 10 parts of water) for the same length of time; again remove, and wash for 1 hour in running water; then dry.

Putty.

1.—It is well known that common putty becomes exceedingly hard with age, which renders the removal of glass from sashes peculiarly difficult. A practical man tells us that he thinks himself lucky if he can take out one pane out of three without breakage. It is stated, however, that the putty may be softened by using a paste of caustic potassa, easily prepared by mixing the caustic alkali, or even carbonate of potash or soda, with equal parts of freshly burnt quicklime, which has previously been sprinkled with water, so as to cause it to fall into powder. This is then mixed with water to a paste, and is spread on the putty to be softened. Where one application is not sufficient it is repeated. In order to prevent the paste from drying too quickly, it is well to mix it with less water, adding some soft soap instead.

2.—Take pearlash, 1 lb.; quicklime, 3 lb.; slake the lime in water, then add the pearlash, and make the whole the consistency of paint. Apply it to both sides of the glass and let it remain 12 hours, when the putty will be so softened that the glass may be removed with ease.

3.—Soft soap, rubbed on pretty thick, and allowed to stand about 12 hours or more, will soften putty so that it can be cut out quite easily with a knife.

Putty Powder.—Put tin, as pure as possible, into a glass vessel—a wineglass does very well when making small quantities—and pour in sufficient nitric acid to cover it. Great heat is evolved, and care must be taken not to inhale the fumes, as they are poisonous. When there is nothing left but a white powder, it is heated in a Hessian crucible to drive off the nitric acid.

Rags, Polishing.

1.—Saturate woolen stuff with a solution composed of 3 oz. 4 dr. of Castile soap dissolved in 14 oz. of water: to this solution add 22 dr. of tripoli. Color with coralline.

2.—Serviettes magiques, for polishing articles of metal, consist of a pure wool fabric saturated with soap and tripoli, and dyed with a little coralline. They are produced by dissolving 4 grams of Marseilles soap in 20 grams of water, adding 2 grams of tripoli, and saturating a piece of cloth 70 cm. long and 10 cm. wide with it, allowing to dry.

3.—In 20 oz. of water dissolve 4 oz. of soap, and gradually add 2 oz. of pumice stone or finely powdered emery.

4.—Infusorial earth may be used with advantage. Saturate the best unbleached muslim with this paste. Color with a little aniline red, if desired.

Ropes, Preservation.

1.—The ropes should be dipped, when dry, into a bath containing 20 grams of sulphate of copper per liter of water, and kept in soak in this solution for 4 days, afterward being dried. The ropes will thus have absorbed a certain quantity of sulphate of copper, which will preserve them from the attacks of animal parasites and from rot. The copper salt may be fixed in the fiber by a coating of tar or by soapy water. For tarring the rope, it is best to pass it through a bath of boiled tar, hot, drawing it through a thimble to press back the excess of tar, and suspending it afterward on a staging to dry and harden. In the second method the rope is soaked in a solution of 100 grams of soap per liter of water. The copper soap thus formed in the fiber of the rope preserves it from rot even better than the tar, which acts mechanically to imprison the sulphate of copper, which is the real preservative. It is not stated whether the copper treatment is equally serviceable with dressed as with plain hemp ropes.

2.—To preserve wire rope laid underground, or under water, coat it with a mixture of mineral tar and fresh slaked lime, in the proportion of 1 bu. of lime to 1 bbl. of tar. The mixture is to be boiled, and the rope saturated with it while hot; sawdust is sometimes added to give the mixture body. Wire rope exposed to the weather is coated with raw linseed oil or with a paint composed of equal parts of Spanish brown or lampblack with linseed oil.

Rosin, To Bleach.

Rosin is bleached by melting in a suitable vessel, at a temperature of not more than 600°, and passing steam through the fluid mass. The steam and rosin are then condensed in a receiver and the product dried. Carbonic acid, or a mixture of carbonic acid and nitrogen or hydrogen gas, are introduced sometimes, to perfect decolorization. Rosin oil is one of the products of destructive distillation of rosin, the residuum being tar.

Rouge for Buff Wheels.

The rouge employed by machinists, watchmakers and jewelers is obtained by directly subjecting crystals of sulphate of iron or copperas to a high heat, by which the sulphuric acid is expelled and the oxide of iron remains. Those portions least calcined, when ground, are used for polishing gold and silver. These are of a bright crimson color. The darker and more calcined portions are known as "crocus," and are used for polishing brass and steel. Others prefer for the production of rouge the peroxide of iron precipitated by ammonia from a dilute solution of sulphate of iron, which is washed, compressed until dry, then exposed to a low red heat and ground to powder. Of course, there are other substances besides rouge which are employed in polishing, as, powdered emery, kieselguhr, carborundum rotten stone, etc.

Rust. (See also **Marble, Nickel, Tin, Windows.**

Metals.—1.—Drawing Instruments, Removing Rust from.—a.—Use fine emery paper and crocus cloth.

b.—Mix 10 parts of tin putty, 8 parts of prepared buck's horn and 25 parts of 90% alcohol to a paste. Cleanse the articles with this, and finally rub with soft blotting paper.

2.—Gun Barrels, Grease for Anointing, to Prevent Rust.—Make an ointment of corrosive sublimate and lard. It is said that this will protect gun barrels from rust on the seashore.

3.—Iron and Steel, Rust Preventives. —a.—Caoutchouc oil is said to have proved efficient in preventing rust, and to have been adopted by the German army. It only requires to be spread with a piece of flannel, in a very thin layer, over the metallic surface and allowed to dry up. Such a coating will afford security against all atmospheric influences and will not show any cracks under the microscope after a year's standing. To remove it, the article has simply to be treated withe caoutchouc oil again, and washed after 12 to 24 hours.

b.—A solution of india-rubber in benzine has been used for years as a coating for steel, iron and lead, and has been found a simple means of keeping them from oxidizing. It can be easily applied with a brush, and is as easily rubbed off. It should be made about the consistency of cream.

c.—All steel articles can be perfectly preserved from rust by putting a lump of freshly burnt lime in the drawer or case in which they are kept. If the things are to be moved (as a gun in its case, for instance), put the lime in a muslin bag. This is especially valuable for specimens of iron when fractured, for in a moderately dry place the lime will not want renewing for many years, as it is capable of absorbing a large quantity of moisture. Articles in use should be placed in a box nearly filled with thoroughly pulverzed slaked lime. Before using them rub well with a woolen cloth.

d.—The following mixture forms an excellent brown coating for protecting iron and steel from rust: Dissolve 2 parts of crystallized iron chloride, 2 parts of antimony chloride and 1 part of tannin in 4 parts of water, and apply with a sponge or rag, and let dry. Then another coat of the paint is applied, and again another, if necessary, until the color becomes as dark as desired. When dry it is washed with water, allowed to dry again, and the surface polished with boiled linseed oil. The antimony chloride must be as nearly neutral as possible.

e.—Put about 1 qt. of fresh slaked lime, ½ lb. of washing soda and ½ lb. of soft soap in a bucket; add sufficient water to cover the articles; put in the tools as soon as possible after use, and wipe them up next morning, or let them remain until wanted.

f.—Soft soap, with about half its weight of pearlash; 1 oz. of the mixture in about 1 gal. of boiling water. This is in every-day use in most engineers' shops in the drip cans used for turning long articles bright in wrought iron and steel. The work, though constantly moist, does not rust, and bright nuts are immersed in its for days till wanted, and retain their polish.

g.—Melt slowly together 6 or 8 oz. of lard to 1 oz. of rosin, stirring till cool; when it is semi-fluid it is ready for use. If too thick, it may be further let down by coal oil or benzine. Rubbed on bright surfaces, ever so thinly, it preserves the polish effectually, and may be readily rubbed off.

h.—To protect metals from oxidation—polished iron or steel, for instance—the requisite is to exclude air and moisture from the actual metallic surface; wherefore, polished tools are usually kept in wrappings of oiled cloth and borwn paper, and, thus protected, they will preserve a spotless face for an unlimited time. When these metals come to be, of necessity, exposed, in being converted to use, it is necessary to protect them by means of some permanent dressing, and boiled linseed oil, which forms a lasting film or covering as it dries on, is one of the best preservatives, if not the best. But in order to give it body it should be thickened by the addition of some pigment, and the very best—because the most congenial—of pigment is the ground oxide of the same metal; or, in plain words, rusted iron reduced to an impalpable powder, for the dressing of iron or steel, which thus forms the pigment of red oxide paint.

i.—Slak a piece of quicklime with just water enough to cause it to crumble, in a covered pot, and while hot add tallow to it and work into a paste, and use this to cover over bright work; it can be easily wiped off.

j.—Olmstead's varnish is made by melting 2 oz. of rosin in 1 lb. of fresh, sweet lard, melting the rosin first and then adding the lard, and mixing thoroughly. This is applied to the metal, which should be warm, if possible, and perfectly cleaned; it is afterward rubbed off. This has been well proved and tested for many years, and is particularly well suited for planished and Russian iron surfaces, which a slight rust is apt to injure very seriously.

k.—Use ferroline or white zapon lacquer.

l.—Mix whiting and linseed oil together to form a paste. Put a coat on the iron. It is easily removed, and will prevent rusting.

m.—Thick lubricating petroleum, or solid paraffine, applied to the slightly warmed iron, is one of the best preservatives; in some cases a transparent varnish of copal or shellac is preferable. The main point is to clean the iron properly before the application, from all traces of rust, by means of brushing and a mineral acid, to wash it well, and to neutraize all remaining traces of acid with potash lye, or with lime or some other alkali; then clean and dry thoroughly, and apply your oil, paraffine or varnish.

n.—Boiled linseed oil will keep polished tools from rusting if it is allowed to dry on them. Common sperm oil will prevent them from rusting for a short period. A coat of copal varnish is frequently applied to polished tools exposed to the weather. Woolen materials are the best for wrappers for metals.

o.—Iron and steel goods of all descriptions are kept free from rust by the following: Dissolve ½ oz. of camphor in 1 lb. of hog's lard, take off the scum, and mix as much black lead as will give the mixture an iron color. Iron and steel, and machinery of all kinds, rubbed over with this mixture, and left with it on for 24 hours, and then rubbed with a linen cloth, will keep clean for months. If the machinery is for exportation, it should be kept thickly coated with this during the voyage.

p.—Antimony chloride, 9 parts; crystalized iron chloride, 9 parts; tannin, 4½ parts, in 18 parts of water. Apply with a sponge or rag, let it dry, apply again, if necessary. This mixture forms a brown coating on the article. When dry, wash with water; let it dry, then polish with boiling linseed oil.

q.—A compound of grease and zinc filings is found to be an excellent preventative against rust for iron bolts inserted in wood. It is used to line the bolt hole.

r.—A correspondent sends us the following suggestions: "I have tried many things, but found nothing better than boiled linseed oil to protect instruments and tools (files, saws, guns, etc.) from rusting. It even works best with a kettle used for heating water for bathing. Wipe the metal with a cloth dipped in the oil, and let it dry, which will require only a few minutes. If it is unnecessary to have the metal bright and shining, you need not scour it before the application of the oil; this will combine with the rust, and form a firm, durable coating.

s.—Rub over with a mixture of tallow or lard and thick white-lead paint.

t.—To keep iron goods of any kind, and especially those parts of machines which are made of steel or iron, from rusting, take ½ oz. of powdered camphor, and melt it before the fire in 1 lb. of good lard. To give it a dark color, add as much fine black lead as is necessary to produce the desired effect. Clean the ironwork, and smear it over with this preparation. After this it should be allowed to remain untouched for 24 hours, when the grease should be removed by wiping the ironwork with a soft cloth.

u.—Vaseline is an excellent preservative. Buy by the can, and apply with a brush.

4.—Iron, Protection from Rust.—a.—Otto Hering, of Berlin, has lately patented a method for producing basic oils to protect iron from rust. The oil is made to contain in solution certain basic substances. Either the oil (fatty or mineral) may be saturated with ammonia gas at the ordinary temperature, or organic bases can be dissolved in it. In practice, a combination of these two plans is advisable, the ammonia gas being put into the oil after the organic bases. An advantage claimed for this new rust protector is that it contains no moisture, and is mixed with bodies able to check any tendency to rust formation at the outset.

b.—Barff's Process.—A patented process employed for the protection of the surfaces of iron from rust, effected by artificially coating them with a film of magnetic oxide. The iron is first heated to redness, and steam passed over it. The iron decomposes the steam, liberating oxygen, which latter immediately attacks the iron, forming magnetic or black oxide, Fe_3O_4.

c.—Bright Iron Articles.—The medium in question is produced from the following substances: Zinc white, 30 kgm.; lampblack, 2 kgm.; tallow, 7 kgm.; vaseline, 1 kgm.; olive oil, 3 kgm.; varnish, 1 l. Boil together ¼ hour and add ½ l. of benzine and ¼ l. of turpentine, stirring the mass carefully and boiling for some time. The finished pastelike substance can be readily removed with a rag without the use of solvents.

d.—Underground Iron.—Cotton-seed or linseed oils, 1 lb.; coal tar, 1 lb.; sulphur, 1 lb.; heat separately; mix thoroughly, and heat to 300° F. for about 1 hour, at the end of which time it becomes pasty. Heat the metal to which it is applied.

5.—Iron, Removal of Rust.—a.—A simple and effective way of cleaning rusted iron articles, no matter how badly they are rusted, consists in attaching a piece of ordinary zinc to the articles, and then letting them lie in water to which a little sulphuric acid is added. They should be left immersed several days, or a week, until the rust has entirely disappeared, the time depending on how deeply they are rusted. If there is much rust, a little sulphuric acid should be added occasionally. The essential part of the process is that the zinc must be in good electrical contact with the iron. A good way is to twist an iron wire tightly around the object, and connect this with the zinc. Besides the simplicity of this process, it has the great advantage that the iron itself is not attacked in the least so long as the zinc is in good electrical contact with it. *Domestic Engineering* says that when there is only a little rust, a galvanized-iron wire wrapped around the object will take the place of the zinc, provided the acid is not too strong. The articles will come out a dark gray or black color, and should then be washed thoroughly and oiled. The method is specially applicable to objects with sharp corners or edges, or to files and other articles on which buffing wheels ought not to be used. The rusted iron and the zinc make a short-circuited battery, the action of which reduces the rust back to iron, this action continuing as long as any rust is left.

b.—Iron articles thickly coated with rust may be cleaned by allowing them to remain in a nearly saturated solution of chloride of tin from 12 to 14 hours.

c.—Rust remover: Ground pumice, 30 grams; oleic acid, 20 grams; tallow, 2 grams; paraffine, 4 grams. The last three ingredients are melted together and the powdered pumice is slowly stirred in.

6.—Nickelplated Articles, To Remove Rust from.—Cover the stains with oil or grease for a few days, and then remove the rust by rubbing with a little ammonia. If this does not remove the rust, try very dilute hydrochloric acid. When dry, polish with tripoli or whiting.

7.—Rust Prevention in General.—a.—Melt together 125 parts of lard and 20 parts of camphor, to which a little graphite is added. After thorough cleaning, the mass is rubbed on and allowed to remain 24 hours.

b.—A mixture of petrolatum and kerosene oil is said to be an excellent application for protecting the surface of the metal.

c.—For polished metal use the following: Rosin, 35 parts; talc, in powder, 500 parts; lard, 120 parts; yellow wax, 130 parts; olive oil, 130 parts; oil of turpentine, 130 parts. Mix the rosin, lard, wax and oil, and melt at a low temperature; when melted, stir in the talc, and after removing from the fire add the turpentine, with constant stirring.

d.—Camphor, ½ oz.; dissolve in melted lard, 1 lb.; take off the scum, and mix in as much black lead as will give it an iron color; clean machinery, and smear with compound; after 24 hours remove with a soft linen cloth.

8.—Rust Removal in General.—a.—Cover the metal with sweet oil, well rubbed in, and allow to stand for 48 hours; smear with oil, applied freely with a feather or piece of cotton wool, after rubbing the steel; then rub with unslaked lime, reduced to as fine a powder as possible.

b.—Immerse the article to be cleaned for a few minutes until all dirt and rust is taken off, in a strong solution of potassium cyanide, say about ½ oz. in a wineglassful of water; take out, and clean it with a toothbrush, with some paste composed of potassium cyanide, Castile soap, whiting and water, mixed into a paste of about the consistency of thick cream.

9.—Steel, Removal of Rust.—a.—The following solution, according to the *National Druggist*, may be applied by means of a brush, after having removed any grease by rubbing with a clean, dry cloth: Stannic chloride, 100 grams, are dissolved in 1 l. of water; this solution is next added to one containing 2 grams of tartaric acid dissolved in 1 l. of water, and, finally, adding 20 c.cm. of indigo solution diluted with 2 l. of water. After allowing the solution to act upon the stain for a few seconds it is rubbed clean, first with a moist cloth, later with a dry cloth. To restore the polish, use is made of silver sand and jewelers' rouge.

b.—Immerse the article to be cleaned for few minutes until all dirt and rust are taken off, in a strong solution of cyanide of potassium, say about ½ oz. in a wineglassful of water; take out, and clean it with a tooth brush, with some paste composed of cyanide of potassium, Castile soap, whitening and water; these last are mixed in a paste about the consistency of thick cream.

c.—To remove rust from small hollow castings, dip in dilute sulphuric acid (1 part of commercial acid· to 10 parts of water). Wash in hot lime water, and dry in a tumbler in dry sawdust.

d.—Immerse the articles in kerosene oil; allow them to remain for some time. This will loosen the rust so it will come off easily.

e.—To remove rust from steel, cover the metal with sweet oil, well rubbed in; 48 hours afterward rub with finely pulverized unslaked lime.

f.—Cover the rusted part with oil or fat, let it remain 3 hours, then wipe off with a cloth; take 2 dr. of caustic potash and 4 oz. of opodeldoc; rub on the mixture, and let it remain 10 minutes; rub off with a dry cloth. Or, cover the rusted parts with sweet oil, well rubbed in, and next day cover with finely powdered unslaked lime; potash with this until the rust disappears. Or, take ½ oz. of emery powder, 1 oz. of soft soap, mixed, and well rub in.

g.—Whiting, by weight, 9 parts; oil soap, by weight, 6 parts; cyanide of potassium, by weight, 5 parts; water, by weight, 60 parts. Dissolve the soap in the water, over the fire, and add the cyanide; then, little by little, add the whiting. If the compound is too thick, which may be due either to the whiting or the soap employed, add a little water until a paste is made which can be run into an iron or wooden mold. .This will remove rust from steel and give it a good polish.

h.—Rosin, 35 prats; powdered talc, 500 parts; lard, 250 parts; yellow wax, 130 parts; olive oil, 130 parts; oil of turpentine, 130 parts. Mix the rosin, lard, wax and oil, and melt at a low temperature. When melted, stir in the talc, and after removing from the fire, add the turpentine, with constant stirring.

i.—Rust Paper for Fine Steel.—Wash some pumice in water, powder it fine, and mix linseed-oil varnish with the powder. Apply several coatings of this mixture with a brush to good, firm paper, and after the paper has been dried in the air pass it between smoothing rollers. The following cleaning powder is also recommended: Mix 16 parts by weigt of tin putty with 8 parts of prepared hartshorn, and rub the mixture to a paste with 32 parts of alcohol. The mixture can then be used for cleaning steel articles. Very rusty steel and iron articles should first be washed with hydrochloric acid, diluted with an equal quantity of water, and afterward with pure water, then dried, coated with oil, left for a few days, and finally cleaned with the cleaning powder already described. Finely powdered emery, with a little olive oil, can also be recommended.

10.—Steel Instruments, Small, To Keep from Rusting.—a.—Clean frequently; after using, clean with dry chamois leather and wipe off with an oiled rag.

b.—For this purpose the *Lancet* confidently recommends a mixture of equal parts of carbolic acid and olive oil, smeared over the surface of the instruments. This plan is much used by medical officers in the navy, and is found to preserve the polish and brightness of the steel, however moist and warm the climate may be.

11.—Steel Wire, To Protect from Rust. —Try the following: Dissolve ½ oz. of camphor in 2 oz. of 90% alcohol, and mix this with 2 pt. of fine sperm oil. Allow the wire to remain in contact with this mixture, heated to 180° F., for half an hour; then rub off excess with a soft cotton cloth.

12.—Stoves, To Prevent from Rusting. —Apply kerosene with a cloth. This will prevent stoves from rusting during the summer. Also an excellent material to apply to all iron tools used about a farm.

13.—Tools, To Keep from Rusting.—a.—Put ¼ lb. of soft soap in a pail and add 1 pt. of freshly slaked lime; sufficient water to cover the articles. Place the tools in this mixture as soon as possible after they are used. Wipe them the next morning.

b.—Apparatus for Coating Laboratory Tools.—Metallic tools and other articles, particularly those consisting of iron or steel, which are used in laboratories or other workshops where acid vapors are of frequent occurence, may be protected from rust with a black shining coat, which resists acids, and is but little affected even by a low red heat, in the following manner: Have a sheet-iron box large enough to hold all the tools, etc., to be coated, and provided with a false bottom of wire netting. Underneath this is placed a layer of crushed coal (blacksmith's coal) about 1 cm. deep: then place the tools, which must be entirely free from rust, clean and polished, upon the wire net. The box is then covered and set on a strong fire, which causes the coal to give off tarry consitituents, and the heat continued until the bottom of the box is at a red heat. When all evolution of gas has ceased the box is allowed to become cold, and the tools are taken out, and will be found covered with a beautiful glossy coat. Tongs, shears, pincers, etc., so coated, keep in good condition for months, even in places where the air is constantly mixed with acid vapors

c—To keep tools from rusting, take ½ oz. of camphor and dissolve it in 1 lb. of melted lard; take off the scum, and mix in as much fine black lead (graphite) as will give it an iron color. Clean the tools, and smear with this mixture. After 24 hours rub clean with a soft linen cloth The tools will keep clean for months under ordinary circumstances.

Textiles.—1.—Stains.—By adding 2 parts of cream of tartar to 1 part of oxalic acid, ground fine, and kept dry in a bottle, you will find, by applying a little of the powder to rust stains while the article is wet, that the result is much quicker and better. Wash out in clear warm water to prevent injury to the goods.

2.—Dissolve potassium bioxalate, 200 parts, in distilled water, 8,800 parts; add glycerine, 1,000 parts, and filter. Moisten the rust or ink spots with this solution; let the linen, etc., lie for 3 hours, rubbing the moistened spots frequently, and then wash out well with water.

3.—Soften the spots with a solution of 1 part of ferrocyanide of potassium, 500 parts of water and 1 part of concentrated sulphuric acid; then wash out with soft water, and remove the stains, which, by this time, will have become blue, by a solution of potash.

4.—Soak the stains in a solution of tin chloride, and rinse immediately with much water. The tin salt is much more reliable in removing iron rust, and quicker in its action, than oxalic acid, unless the stains are soaked in a solution of the latter, contained in a tin spoon, when the stains disappear in a short time.

5.—Iron Rust.—a.—This may be removed by salt mixed with a little lemon juice.

b.—Salts of lemon, mixed with warm water, and rubbed over the mark, will, most probably, remove the stains.

c.—Throw on the stain a small quantity of the dry powder of magnesia, rubbing it slightly in with the finger, leaving it there for an hour or two, and then brushing it off, when it will be found that the stain has quite disappeared.

d.—Fresh ink and the soluble salts of iron produce stains which, if allowed to dry, and especially if afterward the material has been washed, are difficult to extract without injury to the ground. When fresh, such stains yield rapidly to a treatment with moistened cream of tartar, aided by a little friction, if the material or color is delicate. If the ground be white, oxalic acid, employed in the form of a concentrated aqueous solution, will effectually remove fresh iron stains.

Sailcloth.

1.—*Impregnation.*—Sailcloth, allowed to lie about in a wet condition, or rolled up wet, will begin to rot, and the spots cannot afterward altogether be removed by washing, and not even by chlorine. If dried in the stretched condition, the cloth will not spoil. This can be done on a fully manned boat, but not always on other crafts. Soap and brush, applied at once, will do some good. There is also a mistaken idea that rinsing in fresh water and drying in the sun will prevent mischief. To avoid all trouble, the sailcloth should be impregnated The weaver's glue has first to be removed, which is accomplished by boiling a roll of about 6 pieces in malt or also in caustic soda In the latter case, every packet must have a fresh lye, but the subsequent washing in dilute hydrochloric acid does not call for a renewal of the bath every time The cloth is dried hanging, as in all subsequent operations; there is more shrinkage on a cylinder. For impregnation, a solution of alum and phenylate of lime is recommended. The impregnated cloth passes between two rolls, the upper of metal, the lower of paper. Finally comes the fixing with soda silicate. Gruene has found the treatment to answer well, and the cloth remains soft. If, after two years or so, a repetition of the impregnation should appear advisable, the cloth may simply be dipped in phenylate of aluminum.

2.—*Bleaching.*—Use a solution of chloride of lime in water, in which the sail may be immersed for a short time and then thoroughly washed and dried in the sun. This will whiten it.

Stains.

1.—Satins may be cleansed with a weak solution of borax or benzine, when greasy. Care should be taken to sponge moderately and lengthwise, not across, the fabric; iron on the wrong side only. White, cream and pink satins may be treated in the same way as colored silks.

2.—*Black.*—Boil 3 lb. of potatoes to a

pulp in 1 qt. of water; strain through a sieve, and brush the satin with it on a board or table. The satin must not be wrung, but folded down in cloths, for 3 hours, and then ironed on the wrong side.

Screws, Rusting.

To prevent screws employed to join machinery from becoming fixed and difficult to remove from oxidation, the *Moniteur Industrielle* recommends a mixture of oil and graphite, and says it will effectually prevent screws from becoming fixed, and protect them for years from rust. The mixture facilitates tightening up, and is an excellent lubricant, and reduces the friction of the screw in its socket. Carbon, of which graphite is largely composed, is the best known lubricant.

Seaweed.

Soak in distilled water for about a day and a night to soften and remove salt, then put it for 12 hours in a solution of 1 part bisulphite of soda to 10 parts of water; at the expiration of this time mix 1 part of sulphuric acid with 5 parts of water and add 1 part of this to the first solution, which has the seaweed in it. Let remain a few hours longer, then soak in several changes of clean water and dry slowly.

Sheepskin.

1.—*Aprons, etc.*—If stained by grease or paint, it will be necessary to first take out these stains, by placing the skin on a clean board and applying, with rubbing, the following mixture: Benzine, 15 fl.oz.; chloroform, 2 fl.dr.; ether, 2 fl.dr.; alcohol, 4 fl.dr. Mix. When the stains are removed then apply the following mixture: Potassium bitartrate, 1 av.oz.; alum, powder, ½ av.oz.; oxalic acid, ½ av.oz.; sour milk, 16 fl.oz. Mix. Apply this mixture with a clean woolen rag, and rub into the skin until quite dry; then dust on the skin some finely powdered pipeclay, and brush off the excess of the adherent powder.

2.—*Rugs and Mats.*—Wash while fresh, in strong soapsuds, first picking from the wool all the dirt that will come out. A little paraffine, 1 tablespoonful to 3 gal. of water, will aid in removing the impurities. Continue to wash the skin in fresh suds till it is white and clean. Then dissolve ½ lb. each of salt and alum in 3 pts. of boiling water, put into it water enough to cover the skin, which should soak in the solution 12 ours, and then be hung on a line to drain. When nearly dry, nail it, wool side in, on a board, or the side of a barn, to dry. Rub into the skin 1 oz. each of pulverized alum and saltpeter, and if the skin is large double the quantity. Rub for an hour or two. Fold the skin sides together, and hang away for 3 days, rubbing it every day, or till prefectly dry. Then with a blunt knife clear the skin of impurities, rub it with pumice or rotten stone, trim it into shape, and you have a door-mat that will last a lifetime. If it is to be dyed, have a shallow vessel as large as the skin, in which to prepare the dye, so that the skin can be laid wool side down smoothly into the vessel, that all parts may be equally immersed in the dye. This should not be more than 1 in. deep, otherwise the skin might be injured by the hot dye. After coloring, again stretch the skin to dry, and then comb with a wool or cotton card.

3.—Dissolve 1 bar of soap in 2 gal. of boiling water; put 2 qt. of this into a tub or pan containing about 2 gal. of warm water. First rub out the dirt and grease spots with the strong soap liquor, or, if necessary, with fuller's earth; then put the rug or mat into the tub containing the weak soap liquor, and well wash and punch it. Throw away this first liquor, and mix another lot with the same proportions of warm water and dissolved soap, and again well wash the rug; and so continue until it is perfectly clean. Then rinse well in cold water to take out all the soap, and afterward in cold water in which a small quantity of blue has been dissolved. This blue water will only be required for white skins. After this has been done the mat or rug should be wrung out, shaken, and hung up to dry with the skin side toward the sun, but not when the heat is scorching, or the skin will become hard and brittle. It should, while drying, be frequently shaken and hung up, first by one end and then by the other.

Show Cases, To Polish.

A good polishing powder consists of rock alum, burned and finely powdered, 5 parts; levigated chalk, 1 part; mix; apply with a dry brush.

Silk.

1.—*Bleaching.*—a.—The articles to be bleached must be freed from all mechanically adhering dirt, grease, etc. This is effected, according to the nature of the article, and of the impurties to be removed, by means of soap, ammonia, sulphuret of carbon, ether, or alcohol. These cleansing agents must then be entirely removed, either by washing or evaporation. A bleach bath is then made up with the peroxide of hydrogen, either alone or along with small traces of ammonia or of soda lye. The silks are simply laid in this liquid and left to steep as may be required. The process is accelerated by heat not exceeding 77° F., and by the light of the sun. The bleaching process may last from 2 to 14 days. When it is completed the silks are rinsed in condensed steam water and carefully dried.

b.—In China, silks are scoured with carbonate of potash or of soda, but this method has been nearly abandoned in Europe on account of the amount of care and attention it requires. From 10 to 12 lb. of carbonate of soda are required for 100 lb. of raw silk. The scouring bath is not allowed to get hotter than 185° F., and the process may last from 60 to 90 minutes. The action is considered to have gone far enough when the threads give a kind of crackling sound if rubbed with the fingernail. Two or three washings with lukewarm water complete the process. The loss is rarely below 18%, and may rise to 28%.

c.—Caustic soda is used in very weak solutions for coarse kinds of silk. From 3 to 4 lb. of solid caustic is sufficient for 100 lb. of silk. It is dissolved in about 300 gal. of water at 140°, and the yarns are worked for 30 minutes, and then washed. The loss does not exceed 12%

d.—A lye of white soap is made by boiling in water 30 lb. of soap for every 100 lb. of silk intended to be bleached, and in this the silk is steeped till the gum in the silk is dissolved and separated. The silk is then put into bags of coarse cloth and boiled in a similar lye for an hour. By these processes it loses 25% of its original weight. The silk is then thoroughly washed, and steeped in a hot lye composed of 1½ lb. of soap and 90 gal. of water with a small quantity of litmus and indigo diffused. After this it is carried to the sulphuring room; 2 lb. of sulphur are sufficient for 100 lb. of silk. When these processes are not sufficiently successful it is washed with clear *hard* water, and sulphured again.

e.—Scouring with Soap.—This is preeminently the best method, since it preserves and even increases the valued properties of silk, such as feel, brilliancy, etc.; the soap used, however, should always be of the best quality. In the north of Europe, soft potash soaps, generally made from linseed oil, are used; in the south, hard soda soaps, made from olive and other oils, are preferred. Of late years, soap made from oleic acid has been more and more employed. Those soaps are to be preferred which wash off best and leave an agreeable odor. In general, those made from oleic acid and linseed oil wash off best; then follow the soaps made from olive oil, suet, etc. (containing stearic and margaric acids); last, and worst in this respect, comes palm-oil soap, which, on this account, has been almost entirely given up, notwithstanding its agreeable odor. For scouring silks which are to be subsequently dyed, oleic-acid soap may be recommended; but for those destined to remain white, a good olive-oil soap is best. In the latter case, two operations are necessary, "ungumming" (*degommage*) and "boiling." For "ungumming," a boiling solution of 33 lb. of soap to 100 lb. of silk is used, the yarn being worked in this from ½ to ¼ hour. Previous to placing the silk in this bath, however, it should be softened in a weak solution of soda crystals, or, better still, of hydrochloric acid, and should be washed. For "boiling," the same bath may be used (if not too strongly charged with silk glue), except for the purest whites, or when the raw silk is colored; in these cases a fresh bath is imperative. The yarn is lifted from the ungumming bath and allowed to drain; the hanks are then wrung, sewn up in coarse hempen bags or "pockets," and boiled, during 2 or 3 hours, with a solution of 17 lb. of soap per 100 lb. of silk. The yearn is then rinsed in a weak, tepid solution of soda crystals, to avoid the precipitation of any fatty compounds on the silk, after which it is rinsed in cold water. For Japanese and Chinese silks the loss may vary from 18 to 22%; for European silks, 25 to 27%.

2.—*Cleansing*.—a.—No silks look well after washing, no matter how carefully it may be done, and, therefore, it should never be resorted to without absolute necessity. It is recommended to sponge faded silks with warm water and soap, and then to rub them with a dry cloth on a flat board, after which to iron them on the inside with a smoothing iron. Sponging a little with spirits will also improve old black silks. The ironing may be done on the right side, with thin paper spread over them to prevent glazing.

b.—Soft soap, ½ lb.; brandy, 2 teaspoonfuls; proof spirit, 1 pt.; water, 1 pt.; mix well together. Apply with a sponge on each side of the silk, taking care not to crease the silk. Rinse 2 or 3 times, and iron on the wrong side, putting a piece of thin muslin between the silk and the iron.

c.—Black.—To bullock's gall add boiling water sufficient to make it warm, and with a clean sponge rub the silk well on both sides; squeeze it well out, and proceed in like manner. Rinse it in spring water, and change the water until perfectly clean. Dry it in the air, and pin it out on a table; but first dip the sponge in glue water and rub it on the wrong side; then dry before a fire.

d.—White.—White silk is best cleaned by dissolving curd soap in water as hot as the hand can bear and passing the silk through and through, handling it gently, and rubbing any spots till they disappear. The silk should then be rinsed in lukewarm water and stretched by pins to dry.

3.—*Grease.*—Rub the spots on the silk lightly and rapidly with a clean, soft cotton rag dipped in chloroform, and the grease will immediately disappear without injuring the color of the silk. Repeat the operation, if necessary. Be careful to rub the article rapidly and lightly, then finish with a clean, dry cloth. If these precautions are not taken a slight stain is apt to be the result. Very highly rectified benzine, such as is prepared by first-class druggists, will also immediately remove grease from the most delicate colored silks.

4.—*Handkerchiefs, To Keep White.*—In washing silk handkerchiefs, care should be used to prevent their turning yellow. A silk handkerchief should never be boiled, nor have soap rubbed upon it. Make a lather of finely shredded white soap and hot water. Clean the handkerchiefs, and rinse them in plenty of cold water to thoroughly remove all the soap. Press out all the moisture possible, and dry quickly in the sun, ironing them while they are still damp, but not wet.

5.—*Renovating Black Silk.*—The French process is to use a weak solution of coffee water. Do not wet the silk too much, and restore the luster by careful rubbing with a soft silk handkerchief. White silks can be cleaned with a dry powder formed of fine starch and a little laundry blue. Rub over the tissue, and dust out thoroughly. Bread crumbs or chalk should be used for pink or cream-colored silks. Silks may be ironed on the wrong side with a moderately hot iron, or on the right side (to give the fine luster) of well protected by two folds of slightly damped muslin.

Silk Hats.

When a silk hat becomes wet, or from other causes has lost its smoothness and gloss, cleanse it carefully from all dust, then with a silk handkerchief apply petrolatum evenly, and smooth down with the same handkerchief until it is dry, smooth and glossy. This will make a silk at look as good as new.

Silver.

1.—In cleaning silver plate, or any polished metallic surface, it is very essential to keep the polishing material, as well as the rubbing cloths, chamois, etc., in a close box, where they cannot be contaminated with dust. One single grain of sand may produce a scratch that hours of faithful labor cannot obliterate. When this happens the injured article must be sent to the jeweler to have the scratch burnished out.

2.—Silver articles discolored by sulphureted hydrogen may be cleaned by rubbing them with a boiling saturated solution of borax. Another good preparation is a solution of caustic potash with some bits of metallic zinc.

3.—Ammonium carbonate, 1 oz.; water, 4 oz.; Paris white, 16 oz.; mix well, and apply by means of soft leather.

4.—Rouge (very fine) and prepared chalk, equal parts; use dry.

5.—Whiting (fine), 2 parts; white oxide of tin, 1 part; calcined hartshorn, 1 part.

6.—A fresh concentrated solution of hyposulphite of soda will dissolve at once the coat of sulphide of silver, which is the cause of the blackness produced by mustard, eggs, etc., or anything containing sulphur.

7.—*Egg Stains.*—Rub with common salt. A pinch taken between the thumb and finger, and rubbed on the spot with the end of the finger, will usually remove the darkest egg stain.

8.—*Frosting Polished Silver.*—Put them into a bath of nitric acid diluted with an equal volume of distilled water, and let remain for a few minutes. A better effect may be given by dipping the article frequently into the bath until the requisite degree of frosting has been attained. Then rinse, and place for a few moments in a strong bath of potassium cyanide, remove and rinse. The fingers must not be allowed to touch the article during either process. It should be well held with wooden forceps or clamps.

9.—*Ink Stains.*—Silver articles in domestic use, and especially silver or plated inkstands, frequently become badly stained with ink. These stains cannot be removed by ordinary processes, but readily yield to a paste of calcium chloride and water. Javelle water, when at hand, may be used instead.

10.—*Jewelry Filigree.*—To restore the original color when tarnished by wear, or shop-worn, first wash the articles in a solution of 1 fl.oz. of liquid potassa in 20 fl.oz. of water, rinse, and then immerse in a mixture of salt, 1 part; alum, 1 part; saltpeter, 2 parts; dissolved in water, 4 parts. Let them remain for 5 minutes; wash in cold water and dry with chamois leather.

11. — *Liquid Polish.* — a.— Prepared chalk or whiting, 2 oz.; water of ammonia, 2 oz.; water, enough to make 8 oz.

b.—Oxalic acid, 1 oz.; crocus martis, 2 oz.; whiting, 4 oz.; water, to make 1 pt. Mix, and shake before using. This preparation may be used dry (omitting the water), or applied with a little oil, with rubbing, and rubbed dry with whiting.

c.—Mix 8 oz. of prepared chalk, 2 oz. of turpentine, 1 oz. of alcohol, 4 dr. of spirits of camphor and 2 dr. of water of ammonia. Apply with a sponge, and allow to dry before polishing.

d.—Cyanide of potassium, 8 oz.; alcohol, 1 oz.; water of ammonia, 1 oz.; blue vitriol, ½ oz.; Glauber's salts, 1 oz.; soft water, 2 gal. Immerse the silverware in the bath for a few minutes, rinse with clear water, and polish with chamois skin or flannel.

e.—Levigated chalk, 2 parts; oil of turpentine, 4 parts; stronger ammonia water, 4 parts; water, 10 parts. Mix the ammonia and oil of turpentine by agitation, and rub up the chalk in the mixture. Finally, rub in the water gradually, or mix by agitation. Three parts each of powdered tartaric acid and chalk, with 1 part of powdered alum, make a cheap and quick silver-cleaning powder.

12.—*Ornaments.*—Make a strong solution of soft soap and water, and in this boil the articles for a few minutes; 5 minutes will usually be enough. Take out, pour the soap solution into a basin, and as soon as the liquid has cooled down sufficiently to be borne by the hand, with a soft brush scrub the articles with it. Rinse in boiling water, and place on a porous substance (a bit of tiling, a brick, or unglazed earthenware) to dry. Finally, give a light rubbing with a chamois. Articles thus treated look as bright as new.

13.—*Plated Ware.* — a.— Take equal parts of precipitated subcarbonate of iron and prepared chalk.

b.—An impalpable rouge may be prepared by calcining the oxalate of iron.

c.—Take quicksilver with chalk, ½ oz.; and prepared chalk, 2 oz.; mix them. When using, add a small quantity of spirits of wine, and rub with chamois leather. Not recommended.

d.—Put sulphate of iron into a large tobacco pipe; place it in a fire for a quarter of an hour; mix with a small quantity of powdered chalk. This powder should be used dry.

e.—The following makes a liquid polish for silver plate: Cyanide of potassium, 3 to 4 dr.; nitrate of silver, 8 to 10 gr.; water, 4 oz. Apply with a soft brush, wash the object thoroughly with water, dry with a soft linen cloth, and polish with chamois skin. Neither whiting nor powder of any kind should be used for cleaning and polishing; they only waste and scratch the silver..

f.—Take 2 oz. of hartshorn powder and boil it in 1 pt. of water; soak small squares of damask cloth in the liquid, hang them up to dry, and they will be ready for use, and better than any powders.

g.—Add by degrees 8 oz. of prepared chalk, in fine powder, to a mixture of 2 oz. of spirits of turpentine, 1 oz. of alcohol, ½ oz. of spirits of camphor and 2 dr. of aqua ammonia; apply with a sponge and allow it to dry before polishing.

h.—Mix together 1 oz. of fine chalk, 2 oz. of cream of tartar, 1 oz. of rotten stone, 1 oz. of red lead and ¾ oz. of alum; pulverize thoroughly in a mortar. Wet the mixture, rub it on the silver, and when dry rub off with a dry flannel or clean with a small brush.

i.—An excellent preparation for polishing plate may be made in the following manner: Mix together 4 oz. of spirits of turpentine, 2 oz. of 90% alcohol, 1 oz. of spirits of camphor and ½ oz. of spirits of ammonia. To this add 1 lb. of whiting, finely powdered, and stir till the whole is of the consistency of thick cream. To use this preparation, with a clean sponge cover the silver with it so as to give it a coat like whitewash. Set the silver aside till the paste has dried into a powder, then brush it off, and polish with chamois leather. A cheaper kind may be made by merely mixing 90% alcohol and whiting together.

j.—Dissolve 2 dr. of potassium cyanide and 5 gr. of silver nitrate in 2 oz. of water. Apply with a soft brush; dry with a cloth and with chamois skin.

k.—A thin coating of collodion may be used to prevent tarnish where the silver is to be stored for any length of time.

l.—French Plate Powder.—(1) Mix jewelers' rouge with carbonate of magnesia, 1 to 12.

(2) Putty powder, finely powdered, 2 oz.; levigated chalk, 10 oz.

(3) Equal parts of common salt, alum and cream of tartar; dissolve in hot water and boil the plate in it.

14.—*Pomade.*—a.—Mix thoroughly 4½ parts of vaseline with a few drops of essence of mirbane (nitrobenzole); add to this, by stirring, 7½ parts of elutriated chalk, 1½ parts of burnt hartshorn, 1½ parts of pulverized *ossa sepia* (cuttlebone). The mixture should be of the consistency of butter.

b.—Fine chalk, ½ lb.; pipeclay, 3 oz.; white lead, 2 oz.; magnesia (carbonate), ¾ oz.; jewelers' rouge, ¾ oz.

15.—*Powders.*—a.—The best polish for silverware—that is, the polish that, while it cleans, does not too rapidly abrade the surface—is levigated chalk, either alone or with some vegetable acid, like tartaric, or with alum. The usual metal polishes, such as tripoli (diatomaceous earth), finely ground pumice stone, etc., cut away the surface so rapidly that it requires but a few cleanings to wear through ordinary plating. About as good a formula for rapid polishing, of which we have any practical knowledge, is as follows: White lead, 5 parts; levigated chalk, 20 parts; magnesium carbonate, 2 parts; aluminum oxide, 5 parts; silica, 3 parts; jewelers' rouge, 2 parts. Each of the ingredients must be reduced to an impalpable powder, mixed carefully, and sifted through silk several times to secure a perfect mixture, and to avoid any possibility of leaving in the powder anything that might scratch the silver or gold surface. This may be left in the powder form, or incorporated with soap, made into a paste with glycerine, or other similar material. The objection to mixtures with vaseline or greasy substances is that, after cleaning, the object must be scrubbed with soap and water; while with glycerine, simple rinsing and running water instantly cleans the object.

b.—Caustic ammonia, 5 parts; water, 200 parts; sodium hyposulphite, 20 parts; ammonium chloride, 10 parts.

c.—Sodium hyposulphite has been recommended by Messrs. Tiffany & Co. Use with water.

d.—Have ready a basin containing equal parts of oil of vitriol and water; make the article white in a gas flame (not white heat, but a snowy white, which it will assume after exposure to the flame), then plunge it into the pickle, and there leave it for ½ hour; then dry in boxwood sawdust. Applied to solid ware only.

e.—Heat to a dull red (if there is no lead present), allow to cool, and when cold, boil in a pickle of water acidulated with sulphuric acid (30 parts of water to 1 part of acid) until perfectly white; take out, swill in clean water, and burnish the prominent parts; dry in hot boxwood sawdust.

f.—Commence by cleaning off any kind of dirt which the surfaces of the silver articles have contracted while making, as that would entirely spoil the burnishing. For this purpose, take pumice powder, and with a brush, made very wet in strong soapsuds, rub the various parts of the work, even those parts which are to remain dull, which, nevertheless, receive thus a beautiful white appearance; wipe with an old linen cloth and proceed to the burnishing.

g.—A few drops of nitrobenzol are added to 40 parts of vaseline (common); 50 parts of whiting are now stirred in, together with 10 parts of burnt hartshorn and 10 parts of very finely powdered cuttlebone; mix thoroughly.

h.—Finest whiting, 15 parts; soda, 1½ parts; citric acid, ⅜ part. Reduce to a fine powder. Use by moistening the powder with water.

i.—Use a burnisher, wet with soapy water. Silver can also be polished with Vienna lime.

16.—*Preservation.*—Silverware may be kept bright and clean by coating the articles (warmed) with a solution of collodion diluted with alcohol.

17.—*Soaps.*—a.—For the very finest silverware the following is recommended: Good white or yellow soap, finely shaved, 80 parts; burnt magnesia, 18 parts; jewelers' rouge, finest levigated, 2 parts; water, sufficient. Dissolve the soap in the smallest possible quantity of water by the aid of heat; then incorporate the other ingredients. This will keep silverware, not badly stained, in the highest possible condition.

b.—For ordinary polishing purposes the following is recommended: Good white or yellow soap, shaved fine, 80 parts; tripoli, 8 parts; alum (ammonia), 4 parts; tartaric acid, 4 parts; lead carbonate, 4 parts; water, sufficient.

c.—Good white or yellow soap, shaved fine, 100 parts; levigated putty powder, 4 parts; ammonium carbonate, 8 parts; levigated chalk, 16 parts. If you desire to color the soap, rose pink answers very well. Care must be taken in the preparation of levigated chalk to avoid scratching fine silverware.

d.—Soap, 25 parts; tin oxide, 1 part; ammonium carbonate, 2 parts; chalk, 4 parts. The tin oxide and the chalk must be entirely free from grit, or the silver will, of course, be scratched.

18.—*Tarnish.*—a.—Silver which has become much tarnished may be restored by immersion in a warm solution of 1 part of cyanide of potassium to 8 parts of water. (This mixture is extremely poisonous. Washing well with water, and drying, will produce a somewhat dead white appearance, which may be quickly changed to a brilliant luster by polishing with a soft leather and rouge.

b.—If only slightly tarnished, the following is the most suitable method: Prepare a mixture consisting of 3 parts of best washed and purified chalk and 1 part of white soap; add water until a thin paste is formed; rub with a dry brush; continue the rubbing until the articles are quite bright.

c.—Whiting, mixed with caustic ammonia (spirit of sal ammoniac) to form a paste, may be used. This mixture is very effective in cleaning silver, but is attended with the disadvantage that it has a very unpleasant smell and strongly excites the lachrymal glands.

Silver Nitrate Stains.

1.—In the manipulation of the nitrate of silver bath solutions in photography, the operator frequently receives stains of the salt upon his clothing which are not very attractive in appearance. Stains or marks of any kind made with the above silver or bath solutions may be promptly removed from the clothing by simply wetting the stain or mark with a solution of bichromate of mercury. The chemical result is the change of the black-looking nitrate of silver into chromate of silver, which is whiter, or invisible on the cloth. Bichromate of mercury can be obtained at the drug stores.

2.—Sodium sulphite, 1 oz.; chloride of lime, ½ oz.; water, 2 oz. Mix. Use a nail brush.

3.—Dip the fingers into a strong solution of cupric chloride. In about a minute the silver will be converted into a chloride, and may then be washed off with hyposulphate of soda solution.

4.—The immediate and repeated application of a very weak solution of cyanide of potassium (accompanied by thorough rinsings in clean water) will generally remove these without injury to the colors.

5.—Bichloride of mercury, 5 grams; ammonium chloride, 5 grams; distilled water, 40 grams. Apply the mixture to the spots with a cloth, then rub. This removes, almost instantaneously, even ancient stains on linen, cotton or wool. Skin stains, thus treated, become whitish yellow, and soon disappear.

Silver Stains from Fabrics.

1.—Moisten the spots with water, and then rub them lightly with a solution prepared by dissolving 1 pt. of mercuric chloride and 1 pt. of ammonium chloride in 8 pt. of distilled water.

2.—a.—Moisten the spot with a solution of chloride of copper until the spot has disappeared, then wash, first with hyposulphite of soda and then with water.

b.—Prepare a solution of permanganate of potash, add hydrochloric acid to it, apply to the spot, and then wash it again with hyposulphite of soda, and finally with water.

Sponges.

Bleaching.—1.—As is well known, chlorine and its compounds cannot be used for bleaching sponges, as they impart a yellow color to the latter, which, in addition, become hard and lose their fine texture. The method now generally employed is a water solution of sulphurous acid, and requires from 6 to 8 days and considerable manipulation. According to the latest researches made in Germany, the bleaching of sponges can be performed more conveniently and expeditiously by means of bromine dissolved in water. As is well known, 1 part of bromine requires 30 parts of water to dissolve it, and thus a concentrated solution can easily be obtained by dropping a few drops of the former into a bottle of distilled water and shaking it. The sponges are submerged in this solution, and after the lapse of a few hours their brown color changes to a lighter one, the dark red bromine solution changing at the same time to light yellow. By treating the sponges to a second immersion in a fresh solution they acquire the desired light color in a short time. They are improved still more if finally dipped in dilute sulphuric acid and washed with cold water. It seems strange that such closely allied bodies as chlorine and bromine should act so differently toward the coloring matter in sponges.

2.—Saturate in 1 qt. of buttermilk for 24 hours and rub between the hands.

3.—Soak in dilute muriatic acid (1 part of acid to 1½ parts of water) for 12 hours, wash well with water to remove the lime, then immerse it in a solution of 2 lb. of hyposulphite in 12 lb. of water to which 2 lb. of muriatic acid has been added a moment before. After it is sufficiently bleached, remove, wash again, and dry.

4.—Soak for several days in cold water, renewing the water and squeezing the sponges occasionally. Then wash in warm water, and put into cold water acidulated with hydrochloric acid. Next day take out, and wash thoroughly in soft water; then immerse in an aqueous sulphurous acid (sp. gr. 1.034) for a week. Afterward wash in plenty of water, squeeze, and allow to dry in the air.

5.—Soak in dilute hydrochloric acid to remove the lime, then wash in water, and place for 10 minutes in a 2% solution of potassium permanganate. Their brown appearance on removal from this is due to the deposition of manganous oxide, which may be removed by steeping for about 2 minutes in a 3% solution of oxalic acid to which a little sulphuric acid has been added. As soon as the sponges appear white they are washed out in water to remove the acid. Very dilute sulphuric acid may replace the oxalic acid.

6.—First wash in tepid water and then in a solution of hydrochloric acid (5 c. c. per liter=5 fl.dr. per 7 pt.), which frees the pores from carbonate of lime; next immerse for 24 hours in a solution composed of 5 parts of hydrochloric acid in 100 parts of water, with the addition of 6 parts of hyposulphite of soda.

7.—The sponges are first washed in clean water and then immersed for 24 hours in a solution of 9 l. of water and 1 l. of chlorhydric acid. They are then washed again and immersed in the following solution: Water, 10 l.; bromine, 40 grams.. In 24 hours the blackest and dirtiest sponges become perfectly white.

8.—Prepare two solutions according to the appended formulas: (a) Potassium permanganate, 25 grams; pure water, 1 pt. (b) Sodium hyposulphite, 2 oz.; hydrochloric acid, 1 oz.; water, 1 pt. Dissolve the hyposulphite in the water, add the acid, let stand 24 hours, and decant from the sediment.. The solution should be made in the open air, care being taken not to inhale the fumes that arise. Free the sponges from sand and other extraneous matter first, by beating and then washing thoroughly with water. Squeeze them as dry as possible and then immerse them in the solution of permanganate, allowing them to remain in the liquid a few moments, or until they acquire a dark brown color. After removal from this solution dip the sponges, a few at a time into the hyposulphite preparation, allow them to become thoroughly saturated, and then remove and wash in water until the odor of the solution is entirely removed. Squeeze out, and when nearly dry immerse in a solution of ½ oz. of glycerine to 1 pt. of water, and finally dry in the shade. Care should be taken not to expose the sponges to the action of either bath longer than is actually necessary to effect the desired object. While the substance of the sponge is said to be but slightly affected, if at all, by this treatment, prolonged exposure will be injurious.

Cleansing.—1.—The sponges are first washed in warm water which contains about 20 drops of sodium hydrate solution to the liter; this is followed by clean water; then they are immersed in bromine water and exposed to the sun until white, after which they are washed in water which contains 20 drops of sodium hydrate solution to the liter, followed then by clean water. They should be dried quickly in the sun, if possible.

2.—Common salt, 4 oz.; ammonium carbonate, 2 oz.; water, 4 pts. Soak the sponge in this solution for an hour or two, and rinse in clean water.

Spotting, or Stain Removal.

Spotting should be done in a well lighted room, and the reagents employed may be applied by a glass wash bottle or with a small glass pipette or a piece of glass rod. It is sometimes necessary to heat a small portion of the fabric under treatment; this is best done with a small steam jet with a vulcanite or other non-conducting holder, fitted to a flexible metallic steam pipe. The agents employed in spotting must be very carefully selected as they must not affect the color or colors of the fabrics; the fibers must not be injured in strength or appearance, and no sweal mark or stain must remain after the original stain has been removed. Whenever possible, organic solvents must be employed, as they are less liable to affect the colors, and they have no deleterious effect upon the fibers. In employing inorganic liquids or solutions, it must be borne in mind that acids have an injurious action upon vegetable fibers, and alkalies upon animal fibers; whereas vegetable fibers will withstand the action of alkalies, and animal fibers will withstand acids.

The principal organic solvents employed in spotting are: Acetone, alcohol (methylated spirit), amyl acetate, amyl alcohol, aniline, benzine, benzol, carbon tetrachloride, chloroform, ether, turpentine. These liquids are employed alone or in combination.

Of inorganic substances (in fact, of all spotting agents) the most useful is water—hot or cold. A very large number of stains can be removed by its use—*e.g.*, blood stains, food stains, etc. The stained place is laid upon a clean cloth, or, if possible, is stretched upon two closely fitting concentric rings (such as are employed in darning by machine, etc.). The stained place is carefully sponged with cold or warm water, care being taken to avoid the use of more water than is absolutely necessary; after the removal of the stain the place is rubbed as dry as possible with a dry cloth to avoid the production of sweal mark in dyeing. With silk fabrics, a small quantity o facetic is used in the water; this preserves the scroop and luster of the fabric.

Articles from which stains have been removed by organic solvents can be dried off at once; but if there is a possibility of a sweal mark remaining, the goods can be rinsed through benzine in all cases where the spotting agent is soluble in benzine. Care must be exercised in using very mobile solvents, such as ether as they will very readily spread over a considerable area of the fabric, carrying with them in solution some of the substance which is to be removed, making the small stain into a very much larger one. After treatment with solvents the fabric should be carefully rubbed with a dry cloth to avoid the production of a well-defined edge to the area which has been treated. It must be made to merge gradually into the surrounding fabric, so as to be imperceptible, or practically so.

Where mineral acids have been employed on cotton or linen goods, or on fabrics containing these fibers, the place must be sponged with a weak solution of sodium acetate, which produces the sodium salt of the mineral acid and liberates acetic acid, which is quite harmless. This treatment is safer than merely sponging with water, which does not always remove all traces of sulphuric acid. All inorganic spotting agents employed in stain removal must be thoroughly removed by sponging with water, and in all cases (as with organic solvents) care must be taken to prevent a circular mark being left on the fabric.

After the removal of a stain it is sometimes found that the color of the fabric has been discharged or reduced, or, in many cases, the stained place is found, on examination, to be a spot where scent or other colorless liquid has discharged the color of the fabric. In such cases the color may sometimes be revived by sponging with acetic acid. If this has no effect, the dried fabric may be carefully touched up with a suitable solution of color in benzine.

As a convenient form for reference, the methods which have been indicated are given in tabulated form, as follows:

REMOVAL OF STAINS AND GREASE SPOTS

Nature of Stain.	Silk Goods.	Woolen Goods.	Cotton and Linen Goods.
Grease, oil, wax.	Benzine benzol (see also *Paints* and *Iron Mold*).	As silk goods.	As silk goods.
Paint.	Ether, aniline, acetone, nitrobenzine, chloroform, carbon tetrachloride.	As silk goods.	As silk goods.
Enamel.	As paint, or with a mixture of acetone and amyl acetate.	As silk goods.	As silk goods.
Varnish (oil).	As paint.	As silk goods.	As silk goods.
Varnish (rosin).	Aniline, *or* methylated spirit, *or* carbon tetrachloride and a little methylated spirit.		
Varnish (shellac).	Methylated spirit alone, or with carbon tetrachloride.		

REMOVAL OF STAINS AND GREASE SPOTS—*Continued.*

Nature of Stain.	Silk Goods.	Woolen Goods.	Cotton and Linen Goods.
Sealing wax.	Methylated spirit.	As silk goods.	As silk goods.
Tar and pitch.	Benzine, benzol, aniline, or ether.	As silk goods.	As silk goods.
Blood.	Water, followed by solution of neutral soap in methylated spirit.	As silk goods.	Water, followed by sodium hypochlorite.
Sugar, glue, etc.	Water.	As silk goods.	As silk goods.
Fruit, tea, coffee, wine, beer.	*White Silk.* Water, followed by potassium permanganate and removal of the brown stain produced with sulphurous acid. *Colored Silk.* Water, followed by sulphurous acid, *or* hydrogen peroxide, if the colors are fast to these reagents; otherwise, methylated spirit and soap.	As silk goods.	*White Goods.* Water, followed by sodium hypochlorite. *Colored Goods.* Aqueous soap solution and ammonia.
Iron mold.	Aqueous solution of oxalic acid. Cream of tartar and citric acid.	As silk goods.	Titanous chloride, with or without hydrochloric acid. Oxalic acid.
Ink stains.			
(1) Marking ink (silver).	Solution of potassium cyanide.	As silk goods.	As silk goods.
Marking ink (aniline black).	Aniline; or a solution of benzine soap in chloroform.	As silk goods.	As silk goods.
(2) Copying pad inks.	Methylated spirit and ammonia.	As silk goods.	As silk goods, or, on white goods, dilute caustic soda.
(3) Writing inks.	Dilute mineral acids or oxalic acid.	As silk goods.	Acetic or formic acid, followed by dilute mineral acids or oxalic acid.
Grass stains.	Ether, or soap in methylated spirit.	As silk goods.	As silk goods.
Color stains (substantive and basic).	*White Goods.* Decroline (or other stable hydrosulphite) and acetic acid, *or* methylated spirit and ammonia, *or* hydrogen peroxide. *Colored Goods.* As above, if colors are not affected thereby.	As silk goods.	*White Goods.* Titanous chloride (warm). *Colored Goods-* Titanous chloride (cold and dilute).
Scorch stains.	Potassium permanganate, followed by sulphurous acid, *or* hydrogen peroxide.	Hydrogen peroxide.	Hydrogen peroxide or sodium hypochlorite.

Stones.

1.—To remove grease from stone steps or passages, pour strong soda and boiling hot water over the spot, lay on it a little fuller's earth, made into a thin paste with boiling water, let it remain all night, and if the grease be not removed repeat the process. Grease may sometimes be taken out by rubbing the spot with a hard stone—not hearthstone—using sand and very hot water, with soap and soda.

2.—*Mildew or Mold.*—Try a little strong aqueous solution of caustic soda. It should remain 10 minutes in contact with the stone, which, after washing with water, should be well rubbed with a stiff brush or broom.

Straw and Chip.

1.—*Bleaching.*—a.—The articles, having been previously washed, may be placed for an hour in a weak chloride of lime water, and then hung out on a line to dry slowly. The chloride of lime water should be made by mixing 1 part (by weight) of chloride of lime with 20 parts of water, agitating the mixture with a stick until all the particles of chloride of lime are thoroughly broken up, allowing the mixture to settle, and pouring off the clear portion from the dregs for use.

b.—On a small scale, with such an article as a straw hat, a bannet, a basket, etc., the following method may be followed: The straw, having been well washed with weak soda lye, is rinsed in plenty of clean water, lightly shaken, etc.; remove superfluous moisture, and place, supported on a stick, under a large glazed earthenware pan turned upside down. A very small pipkin, capable of holding about ½ pt., is now placed on the fire, and about ½ oz. of roll brimstone placed in it. When the brimstone is all melted a light is applied to it, so as to cause it to catch fire. The pipkin, with the inflamed sulphur, is now placed under the glazed pan in such a position as not to scorch the article to be bleached.. The spaces between the pan and the table or floor on which it rests must be carefully closed with damp cloths placed around to prevent the escape of the sulphurous-acid gas produced by the combustion of the sulphur. In about 2 hours the pan may be removed, when the straw will be found nicely bleached.

c.—Expose to the fumes of burning sulphur in a close chest or box, or by immersing it in a weak solution of chloride of lime, and afterward washing it well in water. Water, strongly acidulated with oil of vitriol or oxalic acid, is also used for the same purpose. Straw may be dyed with any of the simple liquid dyes.

d.—To Give a Luster.—An ammoniacal solution of bleached lac is employed by some makers.

2.—*Hats.*—Bleaching and Cleaning.—a.—Put a small quantity of salts of sorrel, or oxalic acid, into a clean pan, and pour on it sufficient scalding water to cover the bonnet or hat. Put the bonnet or hat into this liquor, and let it remain in it for about 5 minutes; to keep it covered, hold it down with a clean stick. Dry in the sun or before a clear fire. Or, having first dried the bonnet or hat, put it, together with a saucer of burning sulphur, into a box with a tight-closing lid. Cover it over to keep in the fumes, and let it remain for a few hours. The disadvantage of bleaching with sulphur is that the articles so bleached soon become yellow, which does not happen to them when they are bleached by oxalic acid.

b.—Wash in warm soap liquor, well brushing them both inside and out; then rinse in cold water, and they are ready for bleaching.

c.—Sodium bisulphite, 10 dr.; tartaric acid, 2 dr.; borax, 10 dr. Mix. Moisten a small quantity of the powder and apply it with a tooth brush to the hat.

d.—Barium peroxide (hydrated), 83 grams; sodium bisulphate, powder), 17 grams; borax, 8 grams. Mix with water and apply.

e.—The following appeared in the *Western Druggist:* Tartaric acid, 2 dr. Put up in wax paper. Dissolve in 1 tablespoonful of water, and apply with a tooth brush, and, when clean, rinse off with warm water and put aside to dry.

f.—Hats made of natural (uncolored) straw, which have become soiled by wear, may be cleaned by thoroughly sponging with a weak solution of tartaric acid in water, followed by water alone. The hat, after being so treated, should be fastened by the rim to a board by means of pins, so that it will keep its shape in drying.

g.—Sponge the straw with a solution of sodium hyposulphite, 10 grams; glycerine, 5 grams; alcohol, 10 grams; water, 75 grams. Lay aside in a damp place for 24 hours, then apply: Citric acid, 2 grams; alcohol, 10 grams; water, 90 grams. If the hat has become much darkened in tint by wear, it will probably be necessary to expose it to the action of a more pronounced bleaching agent, such as given under "c."

h.—White Manila.—Sprinkle with water and expose to the fumes of burning sulphur in a tight box.

i.—To Finish or Stiffen.—(1) After cleaning and bleaching, white bonnets should be stiffened with parchment size. Black or colored bonnets are finished with a size made from the best glue. Straw or chip plaits, or leghorn hats and bonnets, may also be cleaned, bleached and finished as above.

(2) Stiffen by the application of a little gum water, and press on a block with a hot iron to bring them back into shape.

(3) If a waterproof stiffening is required, use one of the varnishes for which formulas follow: Copal, 450 parts; sandarac, 75 parts; Venice turpentine, 40 parts; castor oil, 5 parts; alcohol, 800 parts.

(4) Shellac, 500 parts; sandarac, 175 parts; Venice turpentine, 50 parts; castor oil, 5 parts; alcohol, 2,000 parts.

(5) Shellac, 750 parts; rosin, 150 parts; Venice turpentine, 150 parts; castor oil, 20 parts; alcohol, 2,500 parts.

(6) Shellac, 4 oz.; sandarac, 1 oz.; gum thus, 1 oz.; alcohol, 1 pt. In this dissolve aniline dyes of the requisite color, and apply. For white straw, white shellac must be used.

Tallow.

1.—*Bleaching and Hardening.*—In a copper boiler put ½ gal. of water and 100 lb. rendered tallow; melt over a slow fire, and add, while stirring, 1 lb. of oil of vitriol, previously diluted with 12 lb. of water; afterward, ½ lb. of bichromate of potassa, in powder; and lastly, 13 pt. of water, after which the fire is suffered to go down, when the tallow will collect on the surface of the dark green liquid, from which it is separated. It is then of a fine white, slightly greenish color, and possesses a considerable degree of hardness.

2.—*Cleansing and Bleaching.*—Dissolve 1 lb. of alum in 2 gal. of water; the water should be boiling. Now add 20 lb. of tallow, and continue to boil for about an hour, skimming frequently. Stain through stout muslin and allow it to harden.

Tannin, Walnut Shells.

White cottons and linens: Javelle water (liquor sodae chlorinatae), warm chlorine water, concentrated solution of tartaric acid. Colored goods or silks: chlorine water, diluted according to the tissue and color, each application to be followed by washing with water.

Tapestry, Ancient.

Dissolve a bar of soap in 1 gal. of boiling water; when cold, put 1 qt. of this dissolved soap in 1 gal. of cold water. Have ready at hand some pieces of soft flannel, a soft brush, a piece of wash leather, and some clean, dry sheets. First, well brush with a hard, long-haired clothes brush, taking care to remove all the dust from the corners; for this latter purpose it is better to use a small, pointed brush and a pair of bellows. If the tapestry is on the wall, begin to clean it at the top, but do not clean more than one square yard at a time. Dip a piece of flannel into the soap liquor, squeeze it out gently, and well rub it into the tapestry to make it lather, and well brush with a soft brush. Then wring the flannel out of the soap liquor, and dry the square with the soapy flannel and the wash leather, and afterward dry with the sheets. The tapestry is to be dried with the soap in it, for on no account must it be rinsed. Dissolve 4 oz. of tartaric acid in 1 pt. of boiling water, and put it into a pan containing 2 gal. of cold water. Dip a clean sponge into this acid water, equeeze it, and then well rub it into the spot you have just cleaned and dried. When this has been done it must be again well dried with the sheets before being left. And so proceed, a square yard at a time, until the whole is cleaned. The soap liquor must be thrown away and a fresh lot mixed, as often as it becomes dirty. When the tapestry has all been cleaned, and it is quite dry, take a lump of pipeclay and well rub it into it, and then brush it with a clean clothes brush. This last process takes out the soap and spirits, and also brightens the colors. Keep a good fire in the room while you are cleaning the tapestry.

Tar, Pitch, Axle Grease, etc.

1.—White goods: Moisten the goods, wipe the spots with a sponge dipped in oil of turpentine, cover them with filter paper, and pass a hot iron over them several times; finally wash the goods in warm soap water. Colored cotton and woolen goods: Moisten the goods, spread the spot with grease, soap it in thoroughly, allow the soap a few minutes to act, and wash alternately in oil of turpentine and hot water. If this does not work, cover the spot with the yolk of an egg that has been mixed with some oil of turpentine, and allow it to dry. Scratch off and wash it out thoroughly with hot water. Then finally wash the goods in water to which some hydrochloric acid has been added, and rinse out thoroughly in clear river water.

2.—Tar and pitch produce stains easily removed by successive applications of spirits of turpentine, coal-tar naphtha and benzine. If they are very old and hard, it is well to soften them by lightly rubbing with a pledget of wool dipped in good olive oil. The softened mass will then easily yield to the action of the other solvents. Rosins, varnishes and sealing wax may be removed by warming and applying strong alcohol. Care must always be taken that, in rubbing the material to remove the stains, the friction shall be applied the way of the stuff, and not indifferently, backward and forward.

3.—On white goods, soap and oil or turpentine, alternating with streams of water. Colored cottons and woolens, rub in with lard, let lie, soap, let lie again, and treat alternately with oil of turpentine and water. Silks the same, more carefully, using benzine instead of oil of turpentine. Freshly made tar stains can be removed by rubbing with lard and washing with soap and water.

Tiles.

Rub well first with smooth brick or pumice, to remove the injured surface, and then, after an addition of red ocher to give uniform color, when clean, dry, and free from holes, etc., pour over the floor a sufficiency of common oil of olives, such as they use in Italy everywher for this purpose, seeing that the floors of all houses in that country are composed of tiles, which are either oiled simply of cemented smoothly, and painted over with patterns in imitation of carpet or mosaic.

Tin.

All kinds of tins, molds, measures, etc., may be cleaned by being well rubbed with a paste made of whiting and well water. They should then be rubbed with a leather, and any dust remaining on them should be removed by means of a soft brush. Finally, they must be polished with another leather. Always let the inside of any vessel be cleaned first, since in cleaning the inside the outside always become soiled. For very dirty or greasy tins, grated bath brick and water must be used. Petroleum or paraffine and powdered lime, whiting, or wood ashes, will scour tins with the least labor.

Rust Prevention.—Cleanse them, wipe quite dry, and place them near the fire. With this precaution, tinware will last a much longer time than usual.

Tin, To Polish.—1.—Vienna lime, applied with a linen rag.

2.—Use whiting and water with a chamois skin.

3.—A fine finish can be given to tin by burnishing, the burnisher being wet with oxgall diluted with water. Wash with water containing a trace of tartar, and dry.

Tobacco Pipes.

A very simple and effective plan. Cut ½ in. from the end of an ordinary cork and fit it tightly into the bowl of the pipe. Then with a knife cut a hole through the cork wide enough to admit the nozzle of a water tap with a little pressure ; turn on the water gently until the flow through the stem is sufficiently strong, and let it run until the pipe is clean.

Varnish and Oil Colors.

1.—*Clothing.*—On white or colored linens, cottons or woolens, use rectified oil of turpentine, alcohol, lye, and then soap. On silks, use benzine, ether and mild soap, very cautiously.

2.—*Furniture and Floors.*—Where oil colors or varnish are to be removed from the surafce of floors of furniture, it is usual to treat them with soda. As a rule, a solution of ordinary washing soda is employed, and applied cold. This, in time, accomplishes its task, but its action is slow and not very efficient. A far better way is to use caustic soda, which can be bought in iron cans, and use the solution hot. With a hot lye of this sort oil color can be removed in a few minutes, and varnishes nearly as rapidly. As the solution attacks the skin, it should be applied with a cotton or hemp swab.. A bristle brush is useless for the purpose, as the bristles dissolve almost immediately in the lye, leaving nothing but the handle of the brush, while cotton or hemp is not affected. When the wood is clean it should be well washed with water. The strong soda lye darkens the color of oak, but if this be objectionable, it can easily be corrected by brushing the wood over with dilute muriatic acid, washing it thoroughly as soon as the color is satisfactory, and finishing with a weak solution of soda to neutralize the last traces of acid. In applying the acid, neither cotton nor hemp can be used, as they are quickly destroyed, but bristle brushes are not affected unless they are bound with iron. In general, care should be taken never to use muriatic acid in rooms or workshops where iron tools are lying about, as the vapor, even from dilute acid, is quickly diffused through the rooms, and attacks all iron or steel that it can reach. The best way is to make all acid applications in the open air. It is hardly necessary to say that cotton or linen clothes should be worn in using the soda lye, as a drop of lye, falling on woolen cloth, immediately makes a hole.

3.—*Funnels and Measures.*—a.—Funnels and measures used for measuring varnishes, oils, etc., may be cleaned by soaking them in a strong solution of lye or pearlash.

b.—Another mixture for the same purpose consists of pearlash with quicklime in aqueous solution. The measures are allowed to soak in the solution for a short time, when the resinous mater of the paint or varnish is easily removed.

c.—A thin coating of petroleum lubricating oils may be removed, it is said, by the use of naphtha or petroleum benzine.

Veils.

1.—*Black.*—Pass them through a warm liquid of bullock's gall and water; rinse in cold water; then take a small piece of glue, pour boiling water on it, and pass the veil through it; clap it, and frame to dry.

2.—*White.*—Put the veil in a solution of white soap and let it simmer ¼ hour; squeeze it in some warm water and soap until quite clean. Rinse it from soap, and then in clean cold water in which is a drop of liquid blue. Then pour boiling water upon 1 teaspoonful of starch, run the veil through this, and clear it well by clapping it. Afterward, dry it out, keeping the edges straight and even.

Vellum.

1.—Benzine is applied with a sponge. It will remove almost every stain, and does not destroy the texture in the least.

2.—The following method, if carried out carefully, will restore dirty vellum to its original condition. Place the vellum on a board, and damp it well with a sponge, water being applied to both sides. The vellum will then get limp and will stretch. With the dressed side uppermost on the board, drive tacks well in around the four edges, pulling the vellum outward meanwhile as tightly as possible. Allow the vellum to dry naturally, when it will be found that all the creases have disappeared. To remove any obstinate dirt or stains, after the vellum has become dry, and while it is still tacked to the board, wash it with a weak solution of oxalic acid, say a pennyworth of acid dissolved in 1 pt. of water. It may be stated that in all skins of vellum there are transparent patches and certain natural marks, which, of course, will not be removed. (See *Parchment.*) Vellum must not be touched with glass paper, as this would spoil it completely. If it is thin, and is intended for a book cover, it should be lined with white paper. This is best done by again tacking it on the board with the undressed side uppermost, pasting the paper, placing it down, and rubbing it thoroughly, afterward allowing it to dry in this position.

3.—*Cleaning Vellum of Banjo.*—Slightly slacken the bracket screws, then rub the head with a flannel and cold water; a little soap should be used, if necessary; tighten up the head again while still damp.

Velvets Velveteens and Plush.

1.—Silk and cotton velvets, velveteens and plush, when stained or generally soiled through wear and exposure, may be either cleaned or dyed. Slightly soiled fabrics should be brushed to get rid of dust, and then be sponged with a weak solution of borax or benzine. When very much soiled they will have to be dipped in a bath of benzine, weakened by the addition of a little water. The drying should not be too rapid, but thorough. The pile must be brushed quickly the right way. But previous to brushing the pile the back of the fabric must be stiffened. Prepare a strong solution of gum arabic in warm water. On taking the velvet or plush out of the bath, dry it, and then brush the back all over with the gum. This stiffens the fabric, and prevents the pile getting loose. When dry, turn over the velvet on the right side and brush it smartly, so that the pile lies upright, and in the proper direction. If this precaution of stiffening the back is not observed the brushing will only do harm. If stiffened, the pile remains firm, and can be easily brushed up. In the case of figured and parti-colored velvets, this precaution should never be omitted, or the design will be spoiled. Velvet dress trimmings that are faded and greasy may be made to appear like new material by judiciously following the above directions.

2.—Mix 2 tablespoonfuls of liquid ammonia and 2 tablespoonfuls of warm water, and put it on the velvet with a stiff brush, rubbing it well into the pile, so as to take out all stains and creases.

3.—*To Raise the Pile.*—a.—Clean it

with the usual solvent, then hold the wrong side over steam arising from boiling water until the pile rises; or dampen lightly the wrong side of the plush and hold it over a pretty hot oven, not hot enough to scorch, however; or make a clean brick hot, place upon it a wet cloth, and hold the plush over it, and the steam will raise it.

b.—Cover a hot iron with a wet cloth, lay the velvet or plush over it, and beat carefully with a clothes brush. Lay the stuff on a smooth place and do not touch until it is quite dry.

Violins.

1.—Use soap and water, but avoid its running through the "f" holes. Clean the interior with *dry* rice. Do not use spirit.

2.—Moisten the soiled parts with salad oil, then mix the same oil and spirits of wine together in a basin trying its strength first on a part of the neck or scroll, then with a piece of white linen rag dipped in the oil and spirit rub the soiled parts; keep shifting the rag as it gets dirty; it will take several days to do, but keep the parts well soaked where dirty, with oil, after every rubbing; but by no means scrape it.

3.—*Ordinary Paraffine Oil.*—Slightly saturate a rag of soft silk, and proceed to wash your violin therewith. The effect is almost magical; the paraffine dissolves the crust of dirt and rosin and cleans the varnish without injuring.

4.—For the outside, a strongish solution of washing soda, applied with a piece of flannel. If you find the soda removes the varnish (as it does with some oil varnishes), use soap and water and then paraffine. When clean, rub with linseed oil. Spirits of wine removes the old rosin at once, but sometimes takes the varnish with it. For the inside, get a handful of rice, steep it in a solution of sugar and water for 5 minutes, strain off, and nearly dry the rice till just sticky. Put in at soundholes and shake till tired. This will pick up all dirt; then turn out.

Violin Bows.

1.—Take a small piece of flannel, wet it, cold process, well rub it with best yellow soap, double it; holding the hair gently between the finger and thumb, rub gently till clean, using plenty of soap; rinse the flannel wipe off, and then wipe dry with a piece of calico or linen; in an hour afterward it will be ready for the rosin.

2.—A solution of borax and water.

Wall Paper.

1.—To remove all stains or marks, where people have rested their heads, from wall papers, mix pipeclay with water to the consistency of cream, lay it on the spot, and allow it to remain till the following day, when it may be easily removed with a penknife or brush.

2.—If not very dirty, the paper of any room will be much improved by brushing it over in straight lines with a soft broom covered with a clean, soft cloth; if, however, the paper be much soiled, very stale bread is the best thing to clean it with.

3.—The following has been recommended: Mix together 1 lb. each of rye flour and white flour into a dough, which is partially cooked and the crust removed. To this 1 oz. of common salt and ½ oz. of powdered naphthaline are added, and finally 1 oz. of corn meal and ⅛ oz. of burnt umber. The composition is formed into a mass of the proper size to be grasped in the hand, and in use it should be drawn in one direction over the surface to be cleaned.

4.—A method recommended by a practical painter and decorator is to take a soft, flat sponge, being careful that there are no hard and gritty places in it, then get a bucket of new, clean, dry wheat bran from the mill or feed store. To use it, hold your sponge flat side up, and put a handful of bran on it; then quickly turn against the wall, and rub the wall gently and carefully with it; then repeat the operation. Hold a large pan, or spread down a drip cloth to catch the bran as it falls, but never use the same bran twice. Still another way is to use Canton flannel. The best way to use it is to get, say, 3 yards, and then cut it in strips, lengthwise, a foot wide; then roll a strip around a stick 10 in. long, so as to have the ends of the stick covered. Have the stick not more than 1 in. in diameter. Have the cottonous or nap side of the cloth outside. Commence and wipe; when the cloth gets soiled, unroll that much and make a roll of it; wipe again, and repeat. Have your second or soiled roll turn in toward the first or clean roll. Hold them together with the thumb and finger. In this way you can change places on the cloth when soiled and roll the soiled place in, which will enable you to use the whole face of the cloth. To take out a grease spot requires careful manipulation. First take sevral thicknsses of brown wrapping paper and make a pad; place it against the grease spot, and hold a hot flatiron against it, to draw out the grease, which will soak into the brown paper. Be careful to have enough layers of brown paper to keep the iron from scorching or discoloring the wall paper. If the first application does not take out nearly all the grease, repeat with clean brown paper or a blotting pad. Then take an ounce vial of washed sulphuric ether and a soft, fine, clean sponge, and sponge the spot carefully until all the grease disappears. Do not wipe the place with the sponge and ether, but dab the sponge carefully against the place. A small quantity of ether is advised, as it is very inflammable.

5.—There are several ways by which wall paper can be cleaned so that it looks almost as good as new. Take a loaf of bread, state, but not too hard, and cut off one crust; then, taking it in one hand, rub the paper gently with the exposed surface. When the bread looks soiled cut off a very thin slice and proceed with the work. It is best to rub up and down on the paper, and clean each place thoroughly before leaving it.

6.—Another way is to take a loaf of bread, and, after removing the crust, soak it in cloudy household ammonia. It must be so wet that one can work it in the hands into a ball. Rub the paper lightly with it, and as the ball becomes soiled on the outside knead it until a clean surface is exposed. This will remove the dirt and smoke, and freshen the paper wonderfully.

7.—Another plan is to make a soft dough of coarse brown flour mixed with water; it should be stiff enough to handle easily. The paper can be rubbed with it as in the former method.

8.—When there are grease spots on the paper, lay coarse brown paper over them and pass a hot iron over. Fresh paper may be needed several times if the spot is large. When there are spots from which the color has been removed, they can be made to look as good as new by the use of water-color paints. The design should be traced first, and the filling then put in with the paints.

9.—Four oz. of pumice stone, in fine powder, are thoroughly mixed with 1 qt. of flour, and the mass is kneaded with water enough to form a thick dough. This dough is formed into rolls about 2 in. in diameter, and 6 or 8 in. long; each one is sewed up in a piece of cotton cloth and then boiled in water for from 40 to 50 minutes—long enough to render the dough firm. After cooling, and allowing the rolls to stand for several hours, the outer portion is peeled off, and they are then ready for use, the paper being rubbed with them as in the bread process.

10.—*Tapestry Papers.*—Prepare a firm paste with 1 part of powdered pumice stone, 6 parts of wheat flour and a sufficient quantity of water; make of this paste cylinders from 2 to 2½ in. in diameter and 7 or 8 in. long. Inclose these in muslin, sewed as tight as possible, and then put the rollers in a vessel containing boiling water, and continue the boiling for three-quarters of an hour. Take them out, and leave at rest for 12 hours in a cool spot. Then take off the covering. They may be employed for rubbing the papers to be cleaned.

Walls, Smoky.

Brush well, wash with a strong solution of pearlash, rinse at once with clear water; then give the walls, when dry, a thin coat of fresh slaked lime with considerable alum, dissolved in hot water. added. After this is dry, apply whiting in good size. There are a number of preparations on the market for cleaning walls which have become discolored, but most of them seem to be held as a trade secret. A small dirt spot can often be removed with a "dry cleaner" such as is used by artists to clean up their drawings. Grease spots can sometimes be removed by flooding that portion of the wall with benzine; then apply blotting paper and rub with a hot flat-iron. Great care must be taken, however, that no fire is brought in immediate contact with the benzine as it is very explosive and inflammable. This plan should only be used to remove isolated spots and is not adapted for wholesale cleaning.

Water, Polishing.

Whiting, 9 oz. 5 dr.; alcohol, 1 lb.; ammonia, 1 oz. 3 dr. Shake well together.

Wax.

Melt the wax in a jar, and put into it powdered nitrate of soda (Chili saltpeter), in the proportion of 1 oz. to the lb. of wax; afterward add, by degrees, 2 oz. to the lb. of sulphuric acid, diluted with 10 times its weight of water, keeping the wax warm and strrng the whle. Let it stand a short time, and then fill up the jar with hot water, and allow the whole to cool. The wax should then be white. Afterward wash with water to remove any nitric acid that may remain, as it would make the wax yellow.

Wheels, Polishing.

Turn some wood wheels of various sizes and cover them on the face and edge with leather of various qualities; wash leather for use with rouge, and a coarser kind for use with emery, pumice, etc. The leather can be fastened with glue. The best wheels are made by punching disks of leather, cloth, etc., and then screwing these disks tightly together on a mandril; but these take a large quantity of material. Some things can be polished very well with plain wood wheels. Small glass-grinding jobs, for instance, can be easily polished with two wood wheels, one for pumice and water and another for rouge and water. Make your wheels of a size and shape to suit the work you have in hand. A few circular brushes are very useful.

Whiting, To Make Into a Polishing Cake.

1.—Use plaster of paris or dental plaster. Mix with water and apply with a rag.

2—*Balls.*—Whiting can be pressed into balls after moistening it with thin gum water.

Wickerwork.

Make a solution of 1 part of chloride of lime with 20 parts of water; well mix, then let stand, and run off the clear liquid into a wooden tub. Dip the baskets in this and let them stay half an hour; remove them from this solution, then dip in hydrochloric acid and water (1 to 20); let remain ¼ hour, then wash in plenty of water, and let dry in a cool, shady place.

Windows. (See also HOUSEHOLD FORMULAS.)

1.—*Frost.*—In a number of experiments in removing ice or congelation of water from window panes, 14 methods were used. In shops where there are so-called "box windows" the congealing was most apparent, and in some where there was a comparatively dry heat the windows wer not materially affected. The remedies are given in the order of their efficacy: 1, flame of an alcohol lamp; 2, sulphuric acid; 3, aqua ammonia; 4, glycerine; 5, aqua regia; 6, hydrochloric acid; 7, benzine; 8, hydriodic acid; 9 boric acid; 10, alcohol; 11, nitric acid; 12, cobalt nitrate; 13, infusion of nutgalls; 14, tincture of ferrous sulphate. By the use of an alcohol lamp—which, of course, has to be handled with great care—the results were immediate, and the effect more nearly permanent than by any other of the experiments. The sulphuric-acid application was made with a cotton-cloth swab, care being taken not to allow any dripping, and so with all other acids. The effect of the aqua ammonia was almost instantaneous, but the window was frosted again in a short time. With the glycerine there were very good results—but slight stains, on the window, which were subsequently easily removed.

2.—*Paint and Putty.*—Put sufficient saleratus into hot water to make a strong solution, and with this saturate the paint which adheres to the glass. Let it remain until nearly dry, then rub it off with a woolen cloth.

3.—*Polishing Paste.*—Castile soap, 2 oz.; boiling water, 3 oz. Dissolve, and add the following, in fine powder: Precipitated chalk, 4 oz.; French chalk, 3 oz.; tripoli, 2 oz. Mix, and reduce with water to the consistency desired.

4.—*Powder.*—a.—A good cleaning powder for show windows and mirrors is prepared by moistening calcined magnesia with pure benzine, so that a mass is formed sufficiently moist to let a drop form when pressed. The mixture has to be preserved in glass bottles with ground stoppers in order to retain the easily volatile benzine. A little of the mixture is placed on a wad of cotton and applied to the glass plate. Do not use near a fire or light, as the benzine vapor is very inflammable and explosive.

b.—Mix 1 part of olive oil, 1 part of ammonia, 2 parts of lime and 1 part of water to a thick paste.

5.—*Rust.*—Try a mixture of 30 parts of water with 7 parts of hydrochloric acid and a trace of iodine. Rub the plate with a linen rag moistened with the fluid, and then polish.

6.—*Washing.*—a.—Wash the glass in the usual manner with water containing about ½ oz. of concentrated ammonia water to a pailful of water—not more, for fear of removing the paint or varnish from the woodwork. While the glass is wet, and without rinsing, go over the entire surface with a weak solution of hydrochloric acid, prepared by adding to a pailful of fresh water 2 or 3 oz. of strong muriatic acid. This neutralizes the ammonia and the alkali in the glass, and forms some soluble chlorides which aid in the polishing. Finally, dry and polish with a clean cloth. The acid will have no ill effects upon paint or varnish upon the window frames, nor even upon unpainted woodwork. If metal window frames hold the glass, the acid is liable to attack these, and should be avoided, or used cautiously. A weaker acid would be advisable in this case.

b.—In washing windows, a narrowbladed wooden knife, sharply pointed, will take out the dust that hardens in the corners of the sash. Dry whiting will polish the glass, which should first be washed with weak black tea mixed with a little alcohol. Save the tea leaves for the purpose.

c.—Procure a wash leather of convenient size and some "paperhanger's" canvas; 2 yd., divided into 3 pieces, will be a nice size to work with. Have the cut sides hemmed, and they will last a long while. When it is desired, use one; boil or soak for an hour or so in a solution of soda and water, then wring out, and rinse in as many courses of clean water as you like; then partially dry (practice will enable you to judge), fold to a convenient size, and it will be ready for use. The soda solution will now be cool enough for the leather (if too hot it will shrivel the leather); wash in the same manner, and wring superfluous moisture out; then wash the glass thoroughly with it and plenty of elbow grease, and polish off with the canvas.

d.—Window polishing paste is made of 90 parts of prepared chalk and 5 parts each of white bole and Armenian bole, rubbed together into a smooth paste with 50 parts of water and 25 parts of alcohol. This paste is to be rubbed on the window, allowed to dry, and then rubbed off with cloths.

Wood.

1.—*Bleaching.*—In most cases, the staining of wood may be effected so as to produce very bright colors without any previous preparation, as, generally speaking, the mordants employed have a bleaching action on the wood. But in many cases, in consequence of the quality of the wood under treatment, it must be freed from its natural colors by a preliminary bleaching process. To this end it is saturated as completely as possible with a clear solution of 17¼ oz. of chloride of lime and 2 oz. of soda crystals in 10½ pt. of water. In this liquid the wood is steeped for half an hour, if it does not appear to injure its texture. After this bleaching it is immersed in a solution of sulphurous acid to remove all traces of chlorine, and then washed in pure water. The sulphurous acid which may cling to the wood in spite of washing does not appear to injure it, or alter the colors which are applied.

2.—*Furniture How to Improve the Appearance of.*—Mr. G. J. Henkels, of Philadelphia, Pa., suggests that when the polish on new furniture becomes dull it can be renewed by the following process: Take a soft sponge wet with clean cold water, and wash over the article. Then take a soft chamois skin and wipe it clean. Dry the skin as well as you can by wringing it in the hands, and wipe the water off the furniture, being careful to wipe only one way. Never use a dry chamois skin on varnished work. If the varnish is defaced, and shows white marks, take linseed oil and turpentine in equal parts, shake them well in a phial, and apply a very small quantity on a soft rag until the color is restored; then with a clean, soft rag wipe the mixture entirely off. In deeply carved work the dust cannot be removed with a sponge. Use a stiff-haired paint brush instead of a sponge. The cause of varnished furniture becoming dull, and the reason why oil and turpentine restore its formed polish, it will be appropriate to explain. The humidity of the atmosphere and the action of gas cause a bluish-white coating to collect on all furniture, and show conspicuously on bright polished surfaces, such as mirrors, pianos, cabinet ware and polished metal. It is easily removed as previously directed. The white scratches on furniture are caused by bruising the gum of which varnish is made. Copal varnish is composed of gum copal, linseed oil and turpentine or benzine. Copal is not soluble in alcohol, as other gums are, but is dissolved by heat. It is the foundation of varnish, as the oil is used only to make the gum tough, and the turpentine is required only to hold the other parts in a liquid state, and it evaporates immediately after its application to furniture. The gum then becomes hard and admits of a fine polish. Thus, when the varnish is bruised, it is the gum that turns white, and the color is restored by applying the oil and turpentine. If the mixture is left on the furniture it will amalgamate with the varnish, and become tough. Therefore, the necessity of wiping it entirely off at once. To varnish old furniture, it should be rubbed with pulverized pumice stone and water to take off the old surface, and then varnish with varnish, reduced, by adding turpentine, to the consistency of cream. Apply with a stiff-haired brush. If it does not look well, repeat the rubbing with pumice stone, and, when dry, varnish it again. For a crack, a worm-eaten hole, or a deep flaw, prepare the proper dust, by the admixture of brick dust in flour (also kept ready), or whiting or ocher, or any required tint. Then take well cooked glue, and on a house plate stir it in slowly, while hot, with sufficient powder for your work. Dab the hole or crack with your glue rush, then with a putty knife stir about the mixture on the plate, taking care you have the right color. When sure on this point, take some of the cement on the end of the knife and insert it in the desired place. Then use as much pressure as you possibly can with the blade, and keep smoothing at it. Sprinkle a little of the dry powder on the spot. When tohroughly dry, sandpaper the surface with an old used piece, so as not to abrade the joint. You can then varnish the mending. Where weevil and wood worms have devoured the furniture, cautiously cut out the part till a sound place is reached. Poison the wood with a solution of sulphate of copper injected into the hollow. Let it dry. Cut an angular piece of same wood from your board, and with a sharp chisel make a suitable aperture for its reception. Fix it with glue. When thoroughly dry, work with carving tools or rasp and glass, scraping till the new bit of work exactly matches the old.

3.—*Heat Stains from Polished Wood.*—Fold a sheet of blotting paper a couple of times (making 4 thicknesses of the paper), cover the place with it, and put a hot smoothing iron thereon. Have ready at hand some bits of flannel, also folded, and made quite hot. As soon as the iron has made the surface of the wood quite warm remove the paper, etc., and go over the spot with a piece of paraffine, rubbing it hard enough to leave a coating of the substance. Now with one of the hot pieces of flannel rub the injured surface. Continue the rubbing, using freshly warmed cloths, until the whiteness leaves the varnish or polish. The operation may have to be repeated.

4.—*Mahogany, Spots on.*—Stains and spots may be taken out of mahogany with a little aquafortis and water, or oxalic acid and water, rubbing the part by means of cork, till the color is restored, observing afterward to wash the wood well with water, and to dry and polish as usual.

5.—*Odors of Wood and Mold.*—a.—To free chests and trunks from evil-smelling and other odors, paint them several times with a solution of shellac according to the following directions: To assure a pleasing color to the inside of the box, similar to gold varnish, we should recommend that the shellac solution be thinned down with 1 or 2 parts of alcohol for the first coat; after that the coats may be laid on with the original varnish. At least one coat is advisable for all chests, except such as contain pulverized spices, since the varnish often becomes tacky in these. The varnish is made up of 1 kgm. of shellac, 1 kgm. of alcohol from 90 to 95% pure, 50 grams of boracic acid and 50 grams of castor oil. Pour the alcohol over the shellac, and dissolve it by frequent turning of the vessel. The boracic acid and castor oil may now be added. This varnish is well adapted for the covering of stationary boxes. For this purpose it is well to give the articles 1 or 2 coats of linseed oil, after which 3 coats of the varnish will be sufficient.

b.—The surfaces of the boxes, wooden vessels, etc., affected should be coated with the following mixture: Acetic ether, 100 parts; formaldehyde solution, 6 parts; phenol, 4 parts; tincture of eucalyptus leaves, 60 parts. The boxes to be then exposed in the open air to the sun.

6.—*Polish for Removing Stains.*—Alcohol, 98%, 1 pt.; ground rosin, ½ oz.; gum shellac, 1½ oz. After the rosin and shellac cut in the alcohol, mix in 1 pt. of linseed oil, and give the whole a good shaking. Apply with a cloth or newspaper, and polish with a flannel after applying the solution.

7.—*Polished Wood.*—An encaustic composed of wax, sal soda and a good soap, is excellent for cleaning and polishing at the same time. Shave the wax and the soap, and dissolve them in boiling water; stir frequently, and add the soda. When the wax and soap are thoroughly dissolved place the mixture in a vessel which can be closely covered, and stir constantly till cool. This mixture will remove ink from polished surfaces, and may be satisfactorily applied to marbles, bricks, furniture, tiles and floors.

8.—*Varnished Wood.*—a.—Make a mixture of equal parts of linseed oil, alcohol and oil of turpentine, and with this mixture moisten a flannel rag; rub the spots well, and in a few moments they will vanish; then polish off with a bit of soft blotting paper.

b.—Mix powdered chalk with soda or potash lye.

Wool.

1.—*Bleaching.*—A writer in the *Chemiker Zeitung* recommends the use of the commercial peroxide as containing small quantities of barium phosphate, giving better results than the chemically pure article. The wool is macerated in the peroxide, diluted with about 5 times its volume of water, and rendered perceptibly alkaline by the addition of ammonia, for from 6 to 10 hours, with frequent stirring. Although the color is permanently destroyed by the peroxide, the wool retains a slight yellow tinge, which may be masked by the addition of a little methyl violet, either in the bath, or separately afterward. After the wool has been freed from the liquid, the bleaching is then completed by exposure to the sunlight.

2.—*Cleansing.*—a.—The liquid used for washing must be as hot as possible.

b.—For the removal of greasy dirt, sweat, etc., borax is of so little value that its application would be mere waste. Soap lye alone is better, but the preference must be given to soap lye along with ammonia. This mixture works wonders by quickly dissolving dirt from particular parts of underclothing which are hard to cleanse. It raises and revives even bright colors, and is altogether excellent.

white woolen goods there is nothing which even approaches borax. Soap lye and borax, 1 teaspoonful of borax to each quart of soap lye—if the second lye is too soapy it may be diluted with a little hot water—applied boiling hot, give white woolens a looseness and a dazzing whiteness which they often do not possess when new.

c.—If shrinking is to be entirely avoided, the drying must be accelerated by repeatedly pressing the woolens between soft cloths. In no case should woolens be let dry in the sun, as in this case they become dry and hard. They are best dried in a moderate current of air, and in cold weather in a warm place not too near the stove.

d.—For colored goods there should be prepared a lye of 7 qt. of soft water and 2 oz. of the best soft soap, the quantities being, of course, modified according to judgment and the dirtiness of the articles. The soap is dissolved over the fire, and the lye, properly stirred up, is divided into two vessels, to one of which is added a teaspoonful of ammonia for each quart of lye. The woolens must be entered at a heat which the hand cannot bear, and the fabric must, consequently, be turned and pressed with smooth wooden stirrers. They are then pressed out as far as possible, and transferred to the second lye, containing no ammonia, and which by this time has become so cool that the articles can be pressed by hand, but no twisting or wringing must take place. They are then pressed between 3 or 4 soft, dry towels till the latter no longer become wet.

e.—After 2 or 3 lots of woolens have thus been washed the lye must be heated again—the first lot being put aside to settle, the second being made first—with the addition of ammonia or borax, as the case may be, and fresh lye made for the second.

f.—*Shawls.*—White woolen shawls will not always stand washing successfully. A safe way of clean such an article is to brush all the dust out, spread it on a table, then sprinkle over it a quantity of finely ground white starch (rice of potato, not wheat); fold up the shawl into a square, powdering liberally between each fold. The shawl should be put away for several hours, and then be opened and dusted. The starch will have absorbed all the grease that may have been present, and collected the dust. If such shawls are very dirty they may be pressed between two damp blankets before the starch is put on. Gray and light blue woolen shawls may be treated in the same way, only using slightly blued starch instead of pure white starch. The shawls must be well shaken to get rid of the powder.

Zinc.

1.—To clean zinc, mix 1 part of sulphuric acid with 12 parts of water; dip the zinc into it for a few seconds, then rub with a cloth.

2.—Zinc articles, if small, can be cleaned by being pickled in hydrochloric acid with water added, till the articles are nicely cleaned, in about 3 minutes, without being too strongly attacked, then washed and dried. Large articles like refrigerators are cleaned by being rubbed with a swab dipped in raw spirits, then washed with water, and finished with whiting.

CHAPTER VIII

COLORING OF METALS

CLEANING, DIPPING AND PICKLING

Articles may be cleansed from dirt by washing with water and brushing with white sand, pumice, whiting, etc. Grease and fatty matter, as well as lacquer on old work, may be best removed by boiling in a hot solution of caustic potash or soda, contained in a cast-iron pot. After boiling for some time they should be removed, and, if not perfectly clean, it may be necessary to scour with fine sand, swill in water, and again suspend in the solution.

Aluminum.

Articles of aluminum are cleaned in a very dilute solution of potash, when the surface assumes a bright appearance; wash well with warm water and dry with a warm cloth. Aluminum alloys are treated like copper alloys.

Copper and Its Alloys.

Copper, brass, bronze, etc., become oxidized in ordinary moist air, and, in consequence of the simultaneous presence of carbonic acid, may become gradually converted into carbonates. In fact, the brownish-black to bluish-green deposit often seen on copper, brass and bronze goods is a mixture of oxide and carbonate of copper mixed with oxygen compounds of zinc or tin, respectively, when the copper is present as an alloy of these metals.

Dipping in Nitric Acid, Common Salt and Soot.—Brass, and similar articles, after cleaning in pickle, are rinsed in water, well shaken and drained, then dipped in a bath consisting of 100 parts of nitric acid, 1 part of common salt and 1 part of calcined soot. This mixture attacks te metal with great energy, and, thefore, it should only remain in it a few seconds. The volume of acid should be 20 times that of the articles immersed in it, to prevent undue heating and too rapid weakening of the acid. When removed, the articles should be quickly rinsed in water to prevent the production of nitrous fumes. They then present a fine luster, varying from red to golden yellow and greenish yellow, according to the composition of the alloy.

Whitening Bath.—1.—This consists of old nitric acid, sulphuric acid, common salt and raw soot. Pour into a stoneware vessel a certain quantity of old nitric acid and add twice the volume of commercial sulphuric acid. Allow the mixture to stand till the next day. The copper nitrate of the old nitric acid is converted into copper sulphate, which crystallizes against the sides of the vessel. Decant the clear liquid into another vessel and add 2 to 3% of common salt and an equal quantity of calcined soot. This mixture is less active than the acids used for a bright luster. The bath may be strengthened, when necessary, by the addition of nitric acid and sulphuric acid.

2.—Another dipping liquid may be made with equal parts of nitric acid and sulphuric acid mixed with 40 times their bulk of water and allowed to cool, then adding a quantity of common salt equal to about one-fifth that of the strong acid present.

3.—Or the following may be used: Nitric acid, 1½ lb.; sulphuric acid, 2 lb.; common salt, 10 gr.

4.—Dead Dipping.—To the above ingredients add a mixture of the following if a dead surface is desired: Nitric acid, 1 lb.; strong sulphuric acid, ½ lb.; common salt, 5 gr.; zinc sulphate, 20 gr. The longer the articles remain in this dip the deader will be the surface. They are then thoroughly swilled and dried as quickly as possible. Or, previous to swilling with water they may be momentarily dipped in the bright dipping liquid.

5.—Another liquid for dead dipping may be made of 1 volume of a concentrated solution of potassium bichromate and 2 volumes of a concentrated hydrochloric acid. The articles should be left in this solution for some hours, then well swilled in several wash waters. If, however, they are left exposed to the air for some time without lacquering or further treatment, they become coated with a film of oxide. Dead-dipped articles, while waiting to be bronzed or lacquered, may be kept from oxidizing by immersing in clean water to which half its volume of alcohol has been added. In the case of copper alloys, such as brass, the surface color will depend not only on the original composition of the alloy, but also on the length of time it has been exposed to the action of the acid. The zinc is oxidized more rapidly than the copper, so that the effect of dipipng in nitric acid or other oxidizing liquid is to increase the relative quantity of copper on the surface, and to give to the alloy a richer appearance and a deeper color. When it is desired to clean very small articles, and not to appreciably alter the composition, they may be dipped in a solution of 5 parts of potassium cyanide dissolved in 95 parts of water.

Iron and Steel.

For cleaning iron articles generally, a cold mixture of about 20 measures of water and 1 measure of sulphuric acid is frequently used; but a better liquid is composed of 1 gal. of water, 1 lb. of sulphuric acid, with 1 or 2 oz. of zinc dissolved in it; to this is added ½ lb. of nitric acid. This mixture leaves the iron quite bright, whereas dilute sulphuric acid alone leaves it black, of af a differ-acid alone leaves it black, or of a differ-scoured with sharp sand and brushed with a steel scratch brush.

Lead, Tin, and their Alloys.

These metals are cleaned to remove dirt and grease, as with other metals, by means of a caustic alkali solution, and brushing with sand, etc.

ALUMINUM

Aluminum, To Blacken.

White arsenic, 1 oz.; sulphate of iron, 1 oz.; hydrochloric acid, 12 oz.; water, 12 oz. When the arsenic and iron are dissolved by the acid add the water. The aluminum to be blackened should be well cleaned with fine emery powder, and washed, before immersing in the blackening solution. When the deposit of black is deep enough, dry off with fine sawdust and lacquer.

Coppering.

1.—Sulphate of copper, 30 parts; cream of tartar, 30 parts; soda, 25 parts; water, 1,000 parts. It suffices to plunge the articles to be coppered in this bath, but they have to be well cleaned previously.

2.—By means of a battery: Phosphate of sodium, 50 parts; cyanide of potassium, 50 parts; cyanide of copper, 50 parts; distilled water, 1,000 parts.

BRASS

1.—The following is one of the compositions that turn out a rich color: Lake copper, 1 lb.; tin, 1 oz.; zinc, ½ oz.; lead, ½ oz. Time, 7 to 20 minutes, according to thickness of castings.

2.—Another method is with chloride of platinum. For this purpose they are first heated to redness, and then dipped in a weak solution of sulphuric acid. Afterward they are immersed in dilute nitric acid, thoroughly washed in water, and dried in sawdust. To effect a uniformity in the color they are plunged in a bath consisting of 2 parts of nitric acid and 1 part of rain water, where they are suffered to remain for several minutes. Should the color not be free from spots and patches, the operations must be repeated until the desired effect is produced.

Black.

1.—A very good black color can be obtained on brass by a solution of copper nitrate, 50 parts; water, 100 parts. If the work is too large for immersion, it is heated, and the solution is applied by means of a paint brush, when the heating is continued until the surface is dry. It is then gently rubbed with a linen pad and brushed with or immersed in a solution of potassium sulphide, 10 parts; water, 100 parts; hydrochloric acid, 5 parts. Immersion of the work in the liquid produces much better results, and, after draining off the superfluous liquid it is heated on a hot plate or over a clean fire till dry. We have obtained more uniform results by using a solution about three times more dilute than the preceding solution of copper nitrate, viz.. Copper nitrate, 100 parts; water, 600 parts. The heating process must not be continued longer than is necessary to convert the whole of the green salt which forms on drying into the black copper oxide. A good black can be thus produced on brass in this way without recourse to the second pickling in potassium sulphide, but this second pickling is probably advantageous in fixing the color.

2.—A solution of nitro-muriate of platinum will blacken brass quicker than anything else; but possibly 2 oz. of corrosive sublimate, dissolved in 1 qt. of vinegar, will act quickly enough. This solution is brushed over the brass, allowed to remain till the latter is black, and then wiped off and the brass cleaned and blackleaded.

3.—A very good black varnish may be made by mixing a small quantity of pure lampblack with rather thick brass lacquer, using as little lampblack as possible. Another varnish may be made by fusing 3 lb. of asphaltum, and, when melted, adding ½ lb. of shellac and 1 gal. of oil of turpentine.

4.—If merely wanted to black it, brush on a mixture of best vegetable black and French polish. This will give a nice dead black, or modify the deadness by the addition of polish.

5.—Make a strong solution of nitrate of silver in one dish and of nitrate of copper in another. Mix the two together and plunge the brass into the mixture. Remove and heat the brass evenly until the required degree of dead blackness is obtained.

6.—Black Bronze for Brass.—Dip the article, bright, in nitric acid, rinse the acid off with clean water, and place it in the following mixture until it turns black: Hydrochloric acid, 12 lb.; sulphate of iron, 1 lb.; pure white arsenic, 1 lb. It is then taken out, rinsed in clean water, dried in sawdust, polished with blacklead, and then lacquered with green lacquer.

7.—Take 1 pt. of strong vinegar, 1 oz. of sal ammoniac, ½ oz. of alum, ¼ oz. of arsenic, and dissolve them in the vinegar, and the compound is fit for use. We know brass founders who have been in the habit of using this for several years, and where the metal is good it is seldom found to fail.

8.—The dead black on optical instruments is produced by dipping in a solution of chloride of platinum. To make this, take 2 parts of hydrochloric acid, 1 part of nitric acid, mix in a glass bottle, and put in as much platinum foil as the acid will dissolve when placed in warm sand bath; or, to hasten the solution, heat to nearly the boiling point of the acids; ½ oz. of nitric acid and 1 oz. of hydrochloric acid will absorb about 30 gr. of platinum, but in order to neutralize the acid it is better to have a surplus of platinum. Dip the article or brush in the chloride.

9.—Lustrous Black.—Mix equal parts of copper sulphate and sodium carbonate. These solutions must be hot. Wash the precipitate as it lies on the filter paper, and dissolve immediately in ammonia; there should be an excess of ammonia. Dilute the solution with water (¼), and add a small quantity of plumbago, 20 to 50 gr., depending on the amount of solution used; then heat to 100° F. The brass articles must be thoroughly cleaned, and left in this bath until they are black; wash well in water and dry in sawdust. Prepare only as much solution as is wanted for immediate use.

10.—Blue-black.—Copper carbonate, 7 oz., is dissolved in 1½ qt. of strong ammonia.. A precipitate is formed, and the solution is diluted with 1 qt. of water.

11.—Optical Instruments and Other Brass Work.—For dead black for inside of tubes, use alcoholic shellac varnish and lampblack, equal parts by weight, and thin with enough alcohol to make it flow freely with the brush.

Blue.

1.—The following solution gives the brass first a rosy tint and then colors it violet and blue: Sulphate of copper, 435 gr.; hyposulphite of soda, 300 gr.; cream of tartar, 150 gr.; water, 1 pt. Upon adding to the last solution 300 gr. of ammoniacal sulphate of iron and 300 gr. of hyposulphite of soda there are obtained, according to the duration of the immersion, yellowish, orange, rosy, then bluish shades. Upon polarizing the ebullition, the blue tint gives way to yellow, and finally to a pretty gray. Silver, under the same circumstances, becomes very beautifully colored.

2.—Upon leaving the brass objects immersed in the following mixture, contained in corked vessels, they at length acquire a very beautiful blue color: Liver of sulphur, 15 gr.; ammonia, 75 gr.; water, 4 oz.

Bronzing.

1.—Freshly precipitated arsenious sulphide is dissolved in ammonia, and antimonious sulphide is added until a dark yellow color is produced. Heat the solution carefully to about 95° F. Leave the articles in the bath until they have acquired a dark-brown color, and develop the color by scratch-brushing.

2.—Ordinary gas fittings are pickled; but if you want to get a good bronze you can use either a solution of nitrate of silver or bichloride of platinum. The articles will require blackleading after being bronzed, and should be warmed before being dipped into the bronzing solution.

Brown.

1.—Iron scales, ½ lb.; muriatic acid, ¼ lb.; arsenic, ½ oz.; zinc (solid), ⅛ oz. Keep the zinc in only while it is in use.

2.—With the following solution all the

Bronzing Brass by Simple Immersion

Water.	Nitrate of iron.	Perchl'de of iron.	Permur'te of iron.	Nitrate of copper.	Tersulph. of arsenic.	Muriate of arsenic.	Pot. sol'n sulphur.	Pearlash solution.	Cyanide of potass.	Ferrocy'de potass.	Sulphocy'de potass.	Hyposulph. of soda.	Nitric acid.	Oxalic acid.	Color.
pt.	dr.	dr.	pt.	oz.	gr.	oz.	dr.	dr.	oz.	pt.	dr.	dr.	dr.	oz.	
1	5	..	..	..	..	..	..	..	..	..	..	..	..	..	Brown and every shade to black.
1	..	5	..	..	..	..	..	..	..	..	..	..	..	..	Brown and every shade to black.
1	16	..	..	..	..	..	..	..	..	..	..	16	..	..	Brown and every shade to red.
1	..	..	..	..	..	..	..	..	..	..	..	16	1	..	Brown and every shade to red.
1	..	..	..	1	..	..	..	..	..	..	..	..	..	1	Brownish red.
.	..	..	..	..	..	..	..	..	..	1	..	..	3		Brownish red.
1	..	..	..	..	..	..	..	..	1	..	..	..	4	..	Dark brown.
1	..	..	..	..	30	..	..	6	..	..	..	..	..	..	Yellow to red.
1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	Orange.
2	..	..	1	..	..	..	..	..	..	..	..	..	..	..	Olive green.
1	..	5	..	..	..	..	..	..	..	..	2	..	..	..	Slate.
1	..	..	..	..	..	..	..	..	..	..	..	20	..	..	Blue.
1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	Steel gray.
1	..	..	2	..	..	10	..	..	..	..	..	..	..	..	Black.

In preparation of No. 5, liquid must be brought to a boil, and cooled. In using No. 13, the heat of the liquid must not be under 180°. No. 6 is slow in action. The action of the others is, for the most part, immediate.—(*English pint,* 20 *oz.*—ED.)

shades of brown from orange brown to cinnamon are obtained: Chlorate of potash, 150 gr.; sulphate of copper, 150 gr.; water, 1 qt.

3.—For dark brown: Chlorate of potash, 75 gr.; salt of nickel, 150 gr.; water, 10 oz.

4.—For yellow brown: Salt of nickel, 75 gr.; sulphate of copper, 75 gr.; chlorate of potash, 75 gr.; water, 10 oz.

Curling.

This fine finish is often seen on fine optical brass work. Remove all scratches, and give a high polish by using files, emery paper, Ayr stone, and at last fine rotten stone. Keep wet with water, and produce the curling with the aid of a pointed stick of charcoal. The motion should be circular.

1.—To improve the appearance of brass, tombac and copper goods, they are usually dipped. For this purpose they are first immersed in diluted oil of vitriol (brown sulphuric acid), proportion 1 to 10; next in a mixture of 10 grams of red tartar, 10 grams of cooking salt, ¼ l. of sulphuric acid, as well as ¼ l. of aqua fortis (only for a moment), rinsing off well in water and drying in sawdust. For obtaining a handsome matt gold color, 1-20 part of zinc vitriol (zinc sulphate) is still added to the pickle.

2.—A good "dip" for cast brass is sulphuric acid, 1 qt.; nitric acid, 1 qt.; water, 1 qt.

Dulling Brass.

Take 1 part, by weight, of iron rust, 1 part of white arsenic, and 12 parts of hydrochloric acid; mix. Clean the brass thoroughly, and apply with a brush until the color desired is obtained; then oil well, dry, and lacquer.

Frosting.

If old work, it should be washed or boiled in potash to remove the lacquer, then pickled in water to which a little nitrous acid has been added. It is now dipped in strong nitrous acid (mind your fingers), washed quickly in hot water, and dried in sawdust. The bright parts should now be burnished. To finish: Heat the work on a stove till it is as hot as you can hold it, and then lacquer. This must be done as soon as possible, or it will tarnish.

Gold.

1.—When gilding is of an inferior color it is sometimes necessary to use some upon the article to withstand the action of the materials employed. This condition being fulfilled, the artificial coloring processes may be applied with advantage, and gold surfaces of great beauty obtained. Sulphate of copper, 2 dwt.; French verdigris, 4 dwt. 12 gr.; sal ammoniac, 4 dwt.; niter, 4 dwt.; acetic acid, about 1 oz. The sulphate of copper, sal ammoniac and niter are first pulverized in a mortar, then the verdigris is added, and well mixed with the other ingredients. The acetic acid is then poured in, a little at a time, and the whole worked up together, when a thin mass of a bluish-green color will result. The article to be colored is to be dipped in the mixture and then placed on a clean piece of sheet copper, which is next to be heated over a clear fire until the compound assumes a dull black color; it is now allowed to cool, and is then plunged into a tolerably strong sulphuric-acid pickle, which soon dissolves the coloring salts, leaving the article a fine gold color. Rinse well in hot water to which a small quantity of carbonate of potash should be added; next brush with warm soap and water, then rinse in hot water.

2.—Finely powder a small quantity of sal ammoniac, and moisten with soft water. Heat the article to be colored over a charcoal fire and rub over with this mixture; then dry with bran and whiting.

3.—Wash the brasswork with roach alum dissolved by boiling in strong lye, in the proportion of 1 oz. of alum to 1 pt. of lye, and when dry rub with fine tripoli. Either of these processes will give to brass the appearance and brilliancy of gold.

4.—Gold lacquer for undipped brass is: Alcohol, 4 gal.; turmeric, 3 lb.; gamboge, 3 oz.; sandarac, 7 lb.; shellac, 1½ lb.; turpentine varnish, 1 pt.

Green.

1.—Verditer green, 4 oz.; salt, 4 oz.; wine vinegar, 4 qt.; sal ammoniac, 2 oz.; alum, 1 oz.; French berries, 16 oz. The ingredients should be boiled together.

2.—Sulphate of copper, 120 gr.; hydrochlorate of ammonia, 30 gr.; water, 1 qt.

3.—Dissolve 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda in 1 pt. of water. Immerse the articles in the bronze till of the required tint, as almost any shade from brown to red can be obtained; then well wash with water, dry, and brush. One part of perchloride of iron and 2 parts of water, mixed together and the brass immersed in the liquid, gives a pale or deep olive green, according to the time of immersion. If nitric acid is saturated with copper, and the brass dipped in the liquid and then heated, it assumes a dark green. If well brushed, it may be lacquered with pale gold lacquer, or else polished with oil.

4.—The repeated applications of alternate washes of dilute acetic acid and exposure to the fumes of ammonia, will give a very antique-looking green bronze; but a quick mode of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of 1 part perchloride of iron in 2 parts of water. The tone assumed darkens with the length of immersion.

5.—The articles may be boiled in a strong solution of nitrate of copper.

6.—Lastly, they may be immersed in a solution of 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda in 1 pt. of water. Washing, drying and brushing complete the process.

Iridescence.

1.—To give beautiful iridescence to nickel, brass or copper fixtures, prepare a solution of 1 part of lead acetate to 3 parts of sodium hyposulphite in 48 parts of water, and into this plunge the articles and let stand. Remove from time to time, and as soon as the requisite depth of color is obtained rinse off, and let dry spontaneously. The iridescence is very beautiful, and quite lasting.

2.—a.—Cream of tartar, 75 gr.; sulphate of copper, 75 gr.; water, 10 oz.

b.—Hyposulphite of soda, 225 gr.; water, 5 oz. Mix.

Mottling.

The brass is first polished to the required degree, and if it is a fine surface the mottled appearance is imparted by rubbing over it, with a gyratory motion, a Scotch gray stone moistened with water. If the work is not very fine, a piece of fine emery paper may be used in the same way. If it is coarse, a dead smooth file may be used.

Olive Green.

1.—Copper sulphate, 8 parts; sal ammoniac, 2 parts; water, 100 parts. Boil, and leave the articles suspended in it until the proper color is reached.

2.—Muriatic acid, 1 oz.; nitric acid, 1½ oz.; add palladium or titanium. Dissolve the metal, and add 1 gal. of pure soft water to each pint of the solution.

3.—*Pale Deep Olive Green Bronze.*—Perchloride of iron, 1½ parts; water, 3 parts. Mix, and immerse the brass.

Patina.

1.—This beautiful color was originally produced by articles being exposed for a long time to the action of the atmosphere. The green color is largely imitated by either of the following methods: Copper carbonate is triturated with sandarac varnish. This affords the cheapest and poorest imitation, and is largely used in painting the little iron castings which are so largely sold in Rome for souvenirs.

2.—Copper, 30 grams; concentrated nitric acid, 60 grams; acetic acid, 6%, 600 grams; ammonium chloride, 11 grams; ammonia water, 20 grams. The copper is dissolved in the nitric acid, and as soon as solution is effected the other ingredients are added. The solution must be allowed to stand several days before using The objects to be coated are either dipped into the solution for a moment or the solution is applied to the surface by means of a brush. They are then allowed to dry, and are finally covered with a thin coat of linseed oil.

Red.

After a long ebullition in the following solution we obtain a yellow-brown shade, and then a remarkable fire red: Chlorate of potash, 75 gr.; carbonate of nickel, 30 gr.; salt of nickel, 75 gr.; water, 10 oz.

Silver.

1.—Take 1 part of chloride of silver (the white precipitate which falls when a solution of common salt is poured into a solution of nitrate of silver of lunar caustic), 3 parts of pearlash, 1 part of whiting, and 1½ parts of common salt, or 1 part of chloride of silver and 10 parts of cream of tartar, and rub the brass with a moistened piece of cork dipped in the powder.

2.—Cream of tartar, 23 parts; tartar emetic, 2 parts; dissolve in 500 parts of hot water; add to this, hydrochloric acid, 25 parts; powdered or fine granulated tin, 62½ parts; powdered antimony, 15 parts. Heat to boiling; dip in the articles to be coated. Boil for ½ hour. The brass will have a hard, durable silver-white coating.

Steel Blue.

1.—Dissolve 3 dr. of antimony sulphide and 4 oz. of calcined soda in 1½ pt. of water. To this add 5½ dr. of kermes. Filter, and mix this solution with 5½ dr. of tartar, 11 dr. of sodium hyposulphite and 1½ pt. of water. If polished sheet brass is placed in the warm mixture, it will assume a beautiful steel-blue color.

2.—The brass, laid in a leaden vessel containing hydrochloric acid and a little arsenic acid, assumes iridescent tints, and may be removed when the desired shade of blue is obtained.

Steel Gray.

Antimonic sulphide and fine iron filings, 1 part of each; hydrochloric acid, 3 parts; water, 3 or 4 parts.

Verde.

Antique finish for copper and brass is fully described in Scientific American Supplement 1665.

Violet.

1.—Hyposulphite of soda, 1 lb. 2 oz., is dissolved in 1 gal. of water. In another gal. of water dissolve 6 oz. of lead acetate (crystallized). Mix the two solutions together, and heat from 170 to 180°. Clean the articles thoroughly, and leave them in the solution until the proper color is reached.

2.—A beautiful violet is obtained by immersing the metal for an instant in a solution of chloride of antimony and rubbing it with a stick covered with cotton. During this operation the brass should be heated to a degree just tolerable to the touch.

3.—*Buttons.*—Heat the brightly polished buttons to 140° F., and moisten by means of a pad of cotton wool with a solution of chloride of antimony.

White.

1.—The following gives, in the first place, a red which passes to blue, then to pale lilac, and finally to white: Orpiment, 75 gr.; crystallized sal soda, 150 gr.; water, 10 oz.

2.—In 2 gal. of water dissolve 3 lb. of cream of tartar and 4 lb. of very finely divided tin are added. This bath can also be used for copper.

BRONZING

Antique Bronzes.—In order to give new bronze castings the appearance and patina of old bronze, various compositions are employed, of which the following are the principal ones:

1.—Vinegar, 1 l.; sal ammoniac, 8 grams; potassium bioxalate, 1 gram.

2.—Water, 120 grams; copper sulphate solution, 80 grams (d = 1.46); sal ammoniac, 10 grams; cream of tartar, 8 grams; sea salt, 60 grams.

3.—Vert Antique.—a.—Vinegar, 1 l.; copper sulphate, 16 grams; sea salt, 32 grams; sal ammoniac, 32 grams; mountain green (Sanders green), 70 grams;

chrome yellow, 30 grams; ammonia, 32 grams.

b.—Vinegar, 1 l.; copper sulphate, 16 grams; sea salt, 32 grams; sal ammoniac, 32 grams; mountain green, 70 grams; ammonia, 32 grams.

c.—To obtain darker vert antique, add a little plumbago to the preceding mixtures.

4.—Vert a l'eau.—Vinegar, 1 l.; sal ammoniac, 50 grams; ammonia, 50 grams; mountain green, 70 grams; chrome yellow, 30 grams.

For bronzing, immerse the object in any of the foregoing mixtures, or cover it rapidly with a soft brush. The object will turn more or less green according to the length of time it is immersed or has been under the action of the fluid. The excess of the fluid is removed by means of a long-haired brush, and after that the article is allowed to dry for 24 hours. A second or even third coating may be applied, if necessary, in order to obtain darker shades. The bronze is finished by an energetic brushing with wax or olive oil or a mixture of both.

Rust Prevention.—Free from grease or other dirt by scouring. Dry, and expose to the fumes of a mixture, in equal parts, of hydrochloric and nitric acids, at a temperature of from 550 to 650° F. for 3 to 4 minutes. Let cool, rub over with vaseline, and heat until the vaseline commences to decompose. This will protect from rust, but for appearance sake, the treatment with vaseline should be repeated. This gives a deep bronze hue, which may be varied by changing the proportion of the acids.

Size for Bronze Powder.—To 1 pt. of methylated finish add 4 oz. of gum shellac and ½ oz. of gum benzoin. Put the bottle in a warm place and agitate it occasionally. When the gums are dissolved let it stand in a cool place 2 or 3 days to settle; pour off the clear portion and reserve for finest work; using the sediment, which, by the addition of more alcohol, may be made workable, when strained, for first coat or coarser work. Add the bronze (q. s.) to this, and apply to the clean, smooth, warm iron, using a soft brush. Repeat, after drying, if necessary. Thin with alcohol, if necessary, to avoid wrinkles and brush marks. Varnish over all.

Steel.—Methylated spirits, 1½ pt.; gum shellac, 6 oz.; gum benzoin, ¾ oz. Set the bottle in a warm place; shake occasionally. When dissolved, decant the clear liquid for fine work; strain the dregs through muslin. Mix with the varnish

in quantities to suit, 6 oz. of powdered bronze green, varying the color with yellow ocher and lampblack as desired. Apply the varnish to the articles after cleaning and warming them; give them two coats.

COPPER

1.—*To Color Copper and Nickelplated Objects.*—The *Journal des Applications Electriques* says that 11 different colors may be communicated to well cleaned copper and 8 to nickelplated objects, by means of the following bath: Acetate of lead, 300 gr.; hyposulphite of soda, 600 gr.; water, 1 qt. After the salts are dissolved the solution is heated to ebullition and the metal is afterward immersed therein. At first a gray color is obtained, and this, on the immersion being continued, passes to violet, and successively to maroon, red, etc., and finally to blue, which is the last color. As the substances that enter into the composition of the solution cost but a few cents, the process is a cheap one. It is especially applicable in the manufacture of buttons.

Blacking.

1.—To give a copper article a black covering clean it with emery paper, heat gently in a Bunsen or a spirit flame, immerse for 10 seconds in a solution of copper filings in dilute nitric acid, and heat again.

2.—A new blacking fluid has been invented by M. Mazure. According to *Cosmos*, this liquid has the following formula: Bismuth chloride, 1 part; mercury bichloride, 2 parts; copper chloride, 1 part; hydrochloric acid, 6 parts; alcohol, 5 parts; water, 50 parts. Mix. To use this fluid successfully the articles to be blacked or bronzed must be clean, and free from grease. It may be applied with a brush or a swab, or, better still, the object may be dipped into it. Let the liquid dry on the metal, and then place the latter into boiling water, and maintain the temperature for half an hour. If the color is then not as dark as desired, repeat the operation. After getting the desired color the latter is fixed and much improved by placing for a few minutes in a bath of boiling oil, or by coating the surface with oil and heating the object until the oil is driven off.

3.—To color copper black, immerse the object, previously well cleaned, in the following and let remain for from 30 to 45 minutes, and afterward wash well: Antimony chloride, 15 parts; alcohol, 125 parts; hydrochloric acid, sufficient to dissolve. Mix. The less of the acid that is used the better the result. This process deposits a coating of antimony.

4.—Plunge the object in nitric acid, remove, and heat to a dull red. Deposits a coating of copper oxide.

5.—Plunge the copper, previously well cleaned, into the following: Acid, arsenious, 2 parts; hydrochloric acid, 4 parts; sulphuric acid, 1 part; water, 24 parts. Mix. Causes a deposit of arsenic.

6.—*Dull Black.*—Brush over the copper with a solution of platinum chloride diluted with 5 times its bulk of water. When thoroughly dry, rub off with an oiled flannel rag.

7.—*Enameled Copper.*—Clean the copper thoroughly with sand and sulphuric acid, then apply the following mixture: White arsenic, 3 parts; hydrochloric acid, 6 parts; sulphuric acid, 1½ parts; water, 36 parts.

Bluing.

1.—Dip the article in a solution of 2 oz. of liver of sulphur and 2 oz. of chlorate of soda in 1,000 oz. of water.

2.—Dip the article in a solution of ferrocyanide of potassium very strongly acidulated with hydrochloric acid.

3.—Stir the article about constantly in a solution of liver of sulphur in 50 times its weight of water.

Bronzing.

1.—A dilute solution of ammonium sulphide, used cold, yields very beautiful effects, as shown by the following results: This solution works very well for copper, but it is not suitable for brass. The solution works well either hot or cold, strong or dilute. The colors depend more upon the manipulation of the process than upon either temperature or density. Colors may be obtained ranging from a neutral crimson through brown and steel gray to black. This solution may be used for bronzing work which is too large to immerse in the solution, by moistening it with a sponge or cloth, then allowing the articles to stand exposed to the air till they are dry, when they may be scratch-brushed and the moistening repeated if the color is not deep enough, or the bronzing not uniformly distributed. When the right tint is attained the articles should be thoroughly washed, first with warm water, then with cold water, and finally dried out in sawdust and brushed with a wax brush.

2.—Having thoroughly cleaned and polished the surface of the specimen, with a brush apply the common crocus powder, previously made into a paste with water. When dry place it in an iron ladle, or on a common fire shovel, over a clear fire, for about 1 minute, and when sufficiently cool polish with a plate brush. By this process a bronze similar to that on tea urns is produced.

3.—By substituting finely powdered plumbago for crocus powder in the above process a beautiful deep color is produced.

4.—Rub the metal with a solution of potassium sulphide (liver of sulphur, old name), then dry. This produces the appearance of antique bronze very exactly.

5.—Dissolve 2 oz. of verdigris and 1 oz. of sal ammoniac in 1 pt. of vinegar, and dilute the mixture with water until it tastes but slightly metallic, when it must be boiled for a few minutes and filtered for use. Copper medals, etc., previously thoroughly cleaned from grease and dirt, are to be steeped in the liquor at the boiling point, until the desired effect is produced. Care must be taken not to keep them in the solution too long. When taken out they should be carefully washed in hot water and well dried.

Bronzing Fluids for Copper by Simple Immersion

Water.	Nitrate of iron.	Sulphate of copper.	Sulphide of antimony.	Sulphur.	Muriate of arsenic.	Pearlash.	Sulphocyanide of potassium.	Hyposulphite of soda.	Hydrochloric acid.	Color.
pt.	dr.	oz.	dr.	dr.	dr.	oz.	dr.	oz.	dr.	
1	5	..	..	..	..	..	..	..	..	Brown and every shade to black.
1	5	..	..	..	..	..	2		..	Dark brown drab.
1	..	1	..	..	..	..	..	1	2	Dark brown drab.
1	..	..	2	..	..	1	..	.	..	Bright red.
1	..	..	..	1	..	1	..	..	..	Red and every shade to black.
1	..	..	..	..	1	..	..	.	..	Steel gray at 180°.

Browning of Metals.

1.—Scour brightly with fine glass paper, heat over a clear fire, then brush over with a solution prepared as follows: Copper acetate (cryst.), 5%; ammonium chloride, 7%; acetic acid, diluted, 3%; distilled water, 85%. Then rub with 1 part of wax cut in 4 parts of turpentine.

2.—The following solution has been recommended for producing a reddish-brown color, which becomes paler on heating: Dissolve 1 part of copper acetate in 16 parts of water; then add sufficient ammonia to give a deep blue solution, and add 2 parts of potassium sulphide, 3 parts of ammonia, and 10 parts of water. Copper acetate, 60 gr.; water, 2 fl.oz.; ammonia, till the solution is blue; potassium sulphide, 120 gr.; ammonia, 3 fl.dr.; water, 1¼ fl.oz. This solution gave precisely the same results as with potassium sulphide and water, so that the other constituents appear to be useless. The reaction on copper is instantaneous, but brass is simply tarnished.

3.—A very beautiful and pleasing color of a light brown shade may be quickly produced by a mixture of 1 part copper sulphate, 1 part zinc chloride and 1 part water. The above forms a paste which is applied to the article and allowed to dry on it. It is then well washed with water, when a uniform color is obtained. This would be one of the most valuable colors if it were permanent, but, unfortunately, it is changed by the action of light to a dark green, almost black. This change also occurs when the bronze is coated with a film of transparent lacquer, and although we have tried several methods for preventing the change, no suitable remedy has yet been discovered.

Gray.

1.—*Bluish Gray.*—Suspend the object in the following at an almost boiling heat: Sodium sulphide 1 part; antimony sulphite, 1 part; water, 12 parts. Mix. Let remain until the desired tint is obtained, wash rapidly with water, and dry.

2.—*Pinkish Gray.*—A dark color on copper may be obtained by immersion, or by painting the folowing liquid on the articles: Arsenic oxide, 120 gr.; hydrochloric acid, ½ fl.oz.; sulphuric acid, 60 fl.gr.; water, 3 fl.oz. The solution works quickly both on copper and brass, but does not produce a pure black on either; the deposit of arsenic has a dark-gray color, which becomes lighter on scratch-brushing. If copper is dipped momentarily into the solution it receives a very thin, film of arsenic, which, on scratch-brushing, presents a pinkish-gray color.

3.—*Reddish Gray.*—Potassium sulphide, ¼ part; water, 99¾ parts. A coppered ash-tray received a reddish-gray color. The remarks made with regard to the ammonium sulphide solution apply also to potassium sulphide. The color may be modified in the manipulation of the working of both solutions.

Green.

Sodium chloride, 37 parts; ammonia water, 75 parts; ammonium chloride, 37 parts; strong wine vinegar, 5,000 parts. Mix, and dissolve. Apply to the object to be treated with a camel's-hair pencil. Repeat the operation until the desired shade of green is reached.

Bluish Green.—1.—After using the first formula (for green) pencil over with the following solution: Ammonium chloride, 40 parts; ammonium carbonate, 120 parts; water, 1,000 parts. Mix, and dissolve.

2.—Corrosive sublimate, 25 parts; potassium nitrate, 86 parts; borax, 56 parts; zinc oxide, 113 parts; copper acetate, 220 to 225 parts. Mix, and heat together on the surface of the object under treatment.

Bronze Green Dip.—Wine vinegar, 2 qt.; verditer green, 2 oz.; sal ammoniac, 2 oz.; alum, 1 oz.; salt, 2 oz.; alum, ½ oz.; French berries, 8 oz.; boil the ingredients together.

Olive Green.—Cover with a solution of iron and arsenic in hydrochloric acid. Polish with lead minium, warm, and cover with the following varnish: Gum gutta, 1 part; yellow ocher, 1 part; alcoholic varnish, 1 part.. Mix.

Yellow-Green. — 1. — Oxalic acid, 5 parts; ammonium chloride, 10 parts; acetic acid, 30% dilution, 500 parts. Mix, and dissolve. Use as above indicated.

2.—The following will produce the same result: Potassium oxalate, acid, 4 parts; ammonium chloride, 16 to 17 parts; vinegar containing 6% of acetic acid, 1,000 parts. Mix, and dissolve. Use as before.

Oxidizing.

1.—*Copper and Brass.*—Immerse the articles in a solution of 2 oz. of nitrate of iron and 2 oz. of hyposulphite of soda to 1 pt. of water, until the desired shade of oxidation is acquired; then wash, dry, and brush.

2.—*Platinum Solution.*—Dissolve sufficient platinum in aqua regia, and carefully evaporate the resulting solution (chloride of platinum) to dryness. The dried mass may then be dissolved in alcohol, ether, or water, according to the effect which it is desired to produce, a slightly different effect being produced by each of the solutions. Apply the solution of platinum with a camel's-hair brush, and repeat the operation as often as may be necessary to increase the depth of tone. A single application is frequently sufficient. The ethereal or alcoholic solution of platinum must be kept in a well stoppered bottle, and in a cool place. The aqueous solution of platinum should be applied hot.

Red.

1.—To redden copper, hang it for from a few minutes to an hour, according to the shade wanted, in a 5 to 10% solution of ferrocyanide of potassium in water. By adding a little hydrochloric acid to the solution the color given to the copper may be made to assume a purple shade. On removing the copper dry it in the air, or in fine sawdust; rinse, and polish with a brush or chamois leather, after drying it again.

2.—*Royal Copper Finish.*—The copper coloring is termed royal copper from its intense red color. It is produced by dipping in a solution of 2 dr. of sulphide of antimony, 1 oz. of pearlash to 1 pt. of water, or by boiling the copper articles for 15 minutes in a strong solution of tartar and water.

Silver.

Nitrate of silver, 60 gr.; common salt, 40 gr.; cream of tartar, 7 dr. This will be ready for application when mixed and moistened with a little water.

Steel Gray.

1.—Potassium sulphide, ½ part; water, 99½ parts. A coppered ash tray assumed a dark steel-gray color after immersion in this solution.

2.—Dip the copper articles, which must be previously cleaned and pickled, into a heated solution of hydrochloric acid and antimony chloride.

GOLD

This operation consists of imparting a color to gold articles after every other process has been completed. Its object is to give to alloyed gold all the appearance of fine gold itself, by dissolving out the base metal from the surface of the articles and leaving a facing of gold of a deep, rich color. Two distinct modes of coloring are adopted by jewelers, termed, respectively, dry coloring and wet coloring. The latter is most frequently practiced, as the former cannot well be applied to gold inferior to 18 carat.

Dry Coloring.

This term is applied to the coloring process when no liquids are used as constituents of the mixture. The ingredients used are: Potassium nitrate, 8 oz.; common salt, 4 oz.; alum, 3 oz. These substances are ground to a fine powder, well mixed, and placed in a previously heated blacklead color pot, of the same dimensions as that described for use in wet coloring, but the same pot must not be employed for dry coloring as has been used for the wet process. It is well to get the pot nearly red hot before placing the color in it. The mixture must then be constantly stirred with an iron rod. It will first boil up as a greenish liquid, then solidify, and afterward boil up a second time, and become thoroughly fused, having a brownish-yellow color. At this stage the work, which has been previously annealed and dipped in dilute aquafortis, is dipped in the color, being suspended on a silver or platinum wire, the latter being preferred, and kept in motion for about a minute and a half, then immersed in boiling water containing a little aquafortis. The immersion and swilling are again repeated, when the articles possess a beautiful color. They are then washed in hot water containing a little potash, and finally dried in warm boxwood sawdust. In dry coloring, the work should be as highly polished as possible previous to the coloring, for the brighter it is better will be the final color. The time given above is only intended as a general guide, as some work will color much quicker than others, and the time can only be arrived at by experience. The following mixtures have been recommended for coloring.

Process.—1.—Potassium nitrate, 8 oz.; common salt, 4 oz.; alum, 4 oz.

2.—Sal ammoniac, 4 oz.; potassium nitrate, 4 oz.; borax, 4 oz.

Wet Coloring.

The ingredients of the mixture employed in this process have a powerfully solvent action on the base metal with which the gold is alloyed, and a weaker action on the gold itself, so that the article loses weight in direct ratio to the length of time it is submitted to the coloring process, and this loss is greater as the gold is lower in quality. Gee states that the coloring is hastened, and the loss in weight reduced to a minimum, by using old coloring liquid, and he assumes that the dissolved gold is, to some extent, deposited again on the article, because the loss in weight of some common qualities of gold was found to be very little, and the amount of gold recovered from the spent coloring liquid very small indeed. This statement is in accord with the well-known fact that in any liquid in which a metal, say copper, is electropositive to is deposited on the former. The following has been supplied by an experienced Birmingham jeweler, which he has found to be effective: Potassium nitrate, 12 oz.; common salt, 6 oz.; hydrochloric acid, 3 oz. The nitrate and salt are pounded to a fine powder, and placed in a previously warmed plumbago crucible about 8 by 7 in., then stirred with a wooden spoon for a minute or two. The acid is then added, with about 1 oz. of boiling water, and the mass constantly stirred until it boils up to the top of the pot. The work, which has been previously cleansed in hot potash or soda solution, is then suspended in the coloring liquid by means of a silver or platinum wire for about one minute, then well swilled in boiling water. A little more water is added to the color pot, and when the liquid boils up the work is again immersed for another minute, and swilled in boiling water as before. This operation of dipping and swilling is repeated several times, the coloring liquid being weakened by adding water before each immersion, until the desired appearance is attained. The work is finally well washed in hot water and dried in boxwood sawdust. The whole process takes 5 to 7 minutes. The colored work is next scratch-brushed, on a lathe, with a revolving brush made of very fine brass wire, and having stale beer dropping on it. If the coloring has been properly conducted, a beautiful rich and dead color will be produced.

Process.—1.—

Potassium nitrate......	8	14	15	14
Common salt..........	4	7	7	7
Alum	4	7	7	..
Hydrochloric acid	..	2	1	5
Water in each case	..	..	..	..

2.—The following is a useful mixture for removing tarnish from colored gold articles which have been kept in stock for some time: Bicarbonate of soda, 2 oz.; chloride of lime, 1 oz.; common salt, 1 oz.; water, 16 oz. Well mix the above ingredients, and apply with a soft brush.

IRON AND STEEL

Blacking.

Blue Black.—Clean the object thoroughly, remove every trace of grease, then cover with the following: Copper sulphate, 8 parts; nitric acid, 15 parts; alcohol, 30 parts; water, 125 parts. Mix, and dissolve. Let dry on, and when quite dry rub with a woolen cloth.

Brilliant Black.—Boil together: Sulphur, 1 part; oil of turpentine, 10 parts. While boiling, spread in a very light coating, by means of a pencil, over the surface, and heat in the flame of an alcohol lamp until black.

Gun Metal.—For blacking gun barrels: Solution of nitric acid, 2 oz.; tincture of iron, 4 oz.; alcohol, 3 oz.; sweet spirits of niter, 1 oz.; blue vitriol, 1 oz.; rain water, 1½ pt. Scour the barrel smooth; remove all grease with lime, then coat freely with the mixture with a piece of sponge, but not so as to run about the barrel. Let stand in a cool place for about 10 hours, then remove to a warm room, and let stand till dry, when the rust will fly off and not be sticky or streaky. The barrels are not dry, and must stand until quite dry, or the result will be a red barrel. The scratching must be done with lard, then boil for about 10 minutes; take out, and wipe inside and out; let stand till cool, then scratch to remove the dead rust; wipe with a clean rag, then coat with the mixture lightly; let it stand till dry. Scratch, boil, etc., as in first coat, for 6 coats, when the barrels may be finished by oiling.

Bluing.

Gun Metal.—1.—Revolver.—Sometimes the steel is heated to a light gray color, allowed to cool, and reheated until blue. (a) Get as high a polish as possible on the part which you want to blue. (b) Get an iron box made (thin sheet iron). If for the chamber only, say about 6 in. square; no need for rivets; just doubled together. (c) Pound up some wood charcoal; fill your box with it; put the box on a fire (any fire); stir up the charcoal now and again, till you find it is partly ignited. Now put your chamber into the box of partly ignited charcoal; put it in about midway, so as to have as much heat at the bottom as at top and sides. (d) Have handy a handful of dry powdered lime and a piece of tow or cotton waste; you will want a small pair of tongs, or other means of lifting your article out of the box. When you put the article in the box place it again on the fire. Now you must pay attention to it; lift it out about every 10 minutes, and don't stand looking at it, but at once rub it with the tow dipped in the lime. As quickly as possible put back into the charcoal. Don't let your charcoal get too hot; when you see it getting very hot lift the box off the fire and stand it in any convenient spot; replace on fire again, if necessary. Now, the following is important: Your chamber, in a short time, gets of a purple color, then bright blue. It is very tempting to leave off at this bright blue. Don't. This first blue is no good; at least no good where the article has to be rubbed and cleaned. Continue. The bright blue will depart, leaving your chamber nearly as before you put it in the box. Don't forget every 7 or 10 minutes to take out the article and rub it with the tow and dry lime. It must not be kept long in the air. Presently you should obtain a rich dark blue. Finally, when blued, let it cool, then oil (any oil).

2.—Gun Barrels.—a.—To stain, dissolve 4½ oz. of hyposulphite of soda in 1 qt. of water, also 1¼ oz. of acetate of lead in 1 qt. of water. Mix the two solutions and bring to a boil in a porcelain dish or stone pot. Clean the gun barrel free from grease, oil or varnish, warm the barrel, and smear with the hot solution, using a piece of sponge tied to a stick. When color develops, wash, and wipe dry; finish with boiled linseed oil.

b.—Heat evenly in a muffle until the desired blue color is raised, the barrel being first made clean and bright with emery cloth, leaving no marks of grease or dirt upon the metal when the bluing takes place, and then allow to cool in the air. It requires considerable experience to obtain an even, clear blue.

Without Heat.—1.—Clean every part carefully, and apply nitric acid, 1 part, diluted with 10 parts of water, until a blue film is produced on the surface. Then wash with warm water, dry, and wipe with linseed oil.

2.—Solution of potassium ferrocyanide and water, 1 : 200; solution of ferric chloride, 1 : 200. Mix the two solutions, and dip.

3.—Antimony trichloride, 25 parts; nitric acid, fuming, 25 parts; hydrochloric acid, 50 parts. Apply with a rag, and rub, until the proper color is obtained, with a piece of green oak.

Iron.—Dissolve 140 grams of sodium hyposulphite in 1 l. of water, add a solution of 35 grams of lead acetate in 1 l. of water, and lay the perfectly bright iron objects in the liquid.

Removing Blue from Steel.—To leave it as clean as before coloring, try acetic acid, or a solution of tin chloride (stannous chloride).

Steel.—1.—Try the following: Scour the steel with a small quantity of a strong aqueous solution of soda, rinse in water, warm, and brush over with a solution of ¼ oz. of chloride of iron dissolved in 5 oz. of water, and let it dry; then apply in the same manner a solution of 1-5 of an ounce of pyrogallic acid in 1 oz. of water; dry, and brush. Does not wear well without lacquering. The blue oxide is sometimes imitated by using a thin alcoholic shellac varnish, colored with aniline blue or Prussian blue.

2.—The articles to be blued should have their surfaces cleaned and polished. They may be then heated in fine, clean wood ashes to a temperature of from 500 to 600°, according to the depth of the color required. It is not necessary to watch the temperature, but simply to examine the articles from time to time to see that when cooled in the air they assume the proper color. They should then be immediately removed, and the operation is then completed.

3.—To blue steel without heat, mix finely powdered Prussian blue with rather thin shellac; gently heat the steel and apply the varnish.

Brassing Iron.

Remove all organic matter from the surface of the iron, and plunge it into melted brass. The coating of brass which is spread over the iron may be polished or burnished.

Bronzing.

Lay the object for a moment in a solution of iron perchloride and copper sulphate, with a little added nitric acid. Remove, and dry at a temperature of about 30° C. (85° F.). Finally, suspend in a close box containing a vessel of boiling alcohol, and leave for 20 minutes, keeping the alcohol boiling all the time. Scratch off with a scratch brush. Repeat the operation several times, or until the desired tint is obtained.

Cast Iron.—The *Maschinenbauer* describes the following process for imparting to common cast iron all the rich glow of bronze, without covering it with a metal or an alloy. Thoroughly cleanse the surface, and rub it down smooth; apply evenly a coat of vegetable oil, say sweet or olive oil, and heat the iron object, being careful that the temperature does not rise high enough to burn the oil.

At the moment of decomposition of the oil the cast iron will absorb oxygen, and this forms upon the surface a brown oxide skin or film, which takes a fast hold, and is so hard that it will admit of a high polish, thus bestowing upon the iron a most striking resemblance to bronze.

Gun Barrels.—1.—Nitric acid, ½ oz.; sweet spirits of niter, ½ oz.; alcohol, 1 oz.; sulphate of copper, 2 oz.; water, 30 oz.; tincture of muriate of iron, 1 oz. Mix.

2.—Sulphate of copper, 1 oz.; sweet spirits of niter, 1 oz.; water, 1 pt. Mix. In a few days it will be fit for use.

3.—Sweet spirits of niter, 3 oz.; gum benzoin, 1½ oz.; tincture of chloride of iron, ½ oz.; sulphate of copper, 2 dr.; spirit of wine, ½ oz.; mix, and add 2 lb. of soft water.

4.—Tincture of choride of iron, ½ oz.; spirit of nitric ether, ½ oz.; sulphate of copper, 2 scruples; rain water, ½ pt.

The above are applied with a sponge, after cleaning the barrel with lime and water. When dry they are polished with a stiff brush or iron scratch brush.

5.—Make the following solution: Solution of ferric chloride (s. g. 1.28), 14 parts; mercuric chloride, 3 parts; fuming nitric acid, 3 parts; cupric sulphate, 3 parts; water, 80 parts. Mix. With a brush or pencil go over the barrels with this liquid. Let dry on, then scratch off with the scratch brush. Repeat this 2 or 3 times. Finally plunge the barrels into a 1% solution of potassium sulphide, and let remain for 10 days. At the end of the time wash in hot suds, dry off, and cover with linseed oil, which let dry on.

Iron Castings.—Thoroughly clean, and immerse in a solution of sulphate of copper, when they acquire a coat of the latter metal. They must be then washed in water.

Iron Wire.—The followihg is commended as the best and cheapest process: Clean the wire perfectly, then immerse it in a solution of sulphate of copper (blue vitriol) until covered with a coating of metallic copper. Then wash and immerse the articles in the following solution: Verdigris, 2 oz.; sal ammoniac, 1 oz.; vinegar, 1 pt.; diluted with water until it tastes only slightly metallic, then boiled for a few minutes and filtered. The articles are steeped in this liquor at the boiling point, until the desired effect is produced; but do not keep them in too long. When taken out, wash carefully in hot water, and dry.

Browing.

1.—Dissolve in 4 parts of water 2 parts of crystallized iron chloride, 2 parts of antimony chloride and 1 part of gallic acid, and apply the solution with a sponge or cloth to the article, and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water, and dry, and finally rub the articles over with boiled linseed oil. The metal thus receives a brown tint, and resists moisture. The antimony chloride should be as little acid as possible.

2.—A process having this end in view has been recently patented in Germany by Mr. A. De Meritens. The goods to be browned form the anode of the bath, which consists of ordinary or distilled water. The cathode is formed by the vessel which contains the water, if it is made of iron; otherwise, a plate of iron, copper or carbon is placed in the bath. The water is kept at from 160 to 180° F., and the tension of the current must be sfficiently great to decompose the water. The oxygen which thus is given off at the anode forms in an hour or two a layer of the black oxide of iron (a combination of ferrous and ferric oxide), which is said to polish up very well. Steel is said to give the best results; in the case of cast and wrought iron, the oxide or iron formed separates as a powder, and it is necessary to use distilled water in order to obtain a layer which will adhere to the goods.

Guns.—1.—The following recipe for browing is from the U. S. Ordnance Manual: Alcohol, 1½ oz.; tincture of iron, 1½ oz.; corrosive sublimate, 1½ oz.; sweet spirits of niter, 1½ oz.; blue vitriol, 1 oz.; nitric acid, ¾ oz. Mix, and dissolve in 1 qt. of warm water, and keep in a glass jar. Clean the barrel well with caustic soda water to remove grease or oil. Then clean the surface of all stains and marks by emery paper or cloth, so as to produce an even bright surface for the acid to act upon, and one without finger marks. Stop the bore and vent with wooden plugs. Then apply the mixture to every part with a sponge or rag, and expose to the air for 24 hours, when the loose rust should be rubbed off with a steel scratch brush. Use the mixture and a scratch brush twice, and more, if necessary, and finally wash in boiling water, dry quickly, and wipe with linseed oil, or varnish with shellac.

2.—Sulphate of copper, ¼ av.oz.; corrosive chloride of mercury, 1 av.oz.; tincture of chloride of iron, 4 fl.oz.; alcohol, 4 fl.oz.; strong nitric acid, ½ fl.oz. Mix, and apply to the metal, which must be perfectly clean from all dirt or grease, with a sponge or rag; allow to remain 24 hours, so as to get thoroughly dry, then burnish with a hard brush. To obtain the desired shade of color, repeat the application and burnishing as often as is necessary, and then lacquer the metal with a thin, clear lacquer.

3.—Sulphate of copper, ½ av.oz.; tincture of chloride of iron, 2 fl.dr.; spirit of nitrous ether, 1 fl.dr.; strong nitric acid, 1 fl.dr.; alcohol, 2 fl.dr.; water, sufficient to make 8 fl.oz. Mix, and proceed as above.

Iron or Copper.—1.—The following are taken from *Illustrirte Zeitung fuer Blechindustrie:* Rub the objects with a consistent mass composed of several substances, and burn in the applied layer so as to prevent oxidation. This method finds frequent use on copper ware, not only to avoid oxidation and the tiresome polishing which becomes necessary, but also to impart to the copper, the natural color of which is rather glaring, an appearance more pleasing to the eye. Annealing, and careful cleansing with corrosives, of the articles have to precede the browning process. A dark brown is obtained by stirring equal parts of verdigris and colcothar (English red) in vinegar to a pasty consistency, applying this on the well cleaned and dried parts, heating to redness, and quickly rinsing off in acetate of copper.

2.—Make a paste of 2 parts of finely powdered iron oxide with alcohol. This mass is applied with a brush as uniformly as possible; heat over an open fire, rinse off, and polish with a soft brush. If the desired effect of the color is not produced thereby, the operation must be repeated.

3.—Lighter brown shades are produced by applying a composition of 2 parts of verdigris, 2 parts of vermilion, 5 parts of sal ammoniac and 5 parts of alum with vinegar. After the application the parts are heated and rinsed off.

With the above operations the greatest cleanliness must be observed, and the touching of portions to be browned with sweaty fingers must be avoided, else spots will result, which can only be removed by taking everything off again.

Polish for Iron.—Pulverized asphaltum, 1 lb.; gum benzoin, ⅛ lb.; spirits of turpentine, 2 qt. If needed quickly, keep in a warm place, shaking very often. It can be shaded well with ivory black, finely ground. It should be used on iron exposed to the weather as well as interior work requiring a nice polish. Apply with a brush.

Polish on Iron and Steel.—Oil of turpentine, 15 parts; sulphur, 1½ parts. Boil together. Put a very thin coat on the article, and hold over the flame of an alcohol lamp.

Coppering.

Sulphate of copper, 1½ lb.; dissolve, and add 1 fl.oz. of sulphuric acid.

Frosting Steel.

Clean and polish the metal, flow it quickly with dilute nitric acid, and when the proper point is reached wash well in running water.

Gilding.

1.—Kirchmann says: Rub the surface of the iron with sodium amalgam then apply a strong solution of chloride of gold; on heating, mercury will be driven off and the iron will be gilded.

2.—Articles of steel are heated until they acquire a bluish color, and iron or copper is heated to the same degree. The first coating of gold leaf is now applied, which must be gently pressed down with a burnisher and again exposed to gentle heat; the second leaf is then applied in the same way, followed by a third, and so on; or two leaves may be applied instead of one, but the last leaf should be burnished down while the article is cold.

3.—Polished steel may be beautifully gilded by means of the ethereal solution of gold. Dissolve pure gold in aqua regia, evaporate gently to dryness, so as to drive off the superfluous acid, redissolve in water, and add 3 times its bulk of sulphuric ether. Allow to stand for 24 hours in a stoppered bottle, and the ethereal solution of gold will float on top. Polished steel, dipped in this, is at once beautifuly gilded, and by tracing patterns on the surface of the metal with any kind of varnish beautiful devices in plain metal and gilt will be produced. For other metals the electro process is best.

4.—*Gilding, Varnish.*—a.—Beeswax, 4 oz.; verdigris and sulphate of copper, each 1 oz. Mix.

b.—Beeswax, 4 oz.; verdigris, red ocher and alum, of each 1 oz. Mix. Used to give a red gold color to water gilding.

NICKEL

1.—The following solution gives nickel a rich, velvety black color: Water, 3 l. 785 grams; nickel-ammonium sulphate, 34.02 grams; potassium sulphocyanide, 85.05 grams; copper carbonate, 56.70 grams. The same effect is produced by a solution of arsenic trioxide in ammonium carbonate.

2.—Nickel, as well as copper, can be blackened by brushing with an aqueous solution of platinic chloride.

SILVER

Blackening.

1.—Plunge into a solution of an alkaline sulphide. Remove, and rub with a brush dipped in powdered cream of tartar.

2.—Rub the object with a solution of silver nitrate.

Browning.

To give silver a deep brown color, treat it with a solution of sal ammoniac and copper sulphate, in equal parts, in vinegar.

Burnishing.

Remove all dirt with powdered pumice stone, then brush all parts with strong soapsuds; wipe with a linen cloth, and burnish. Use soapy water as a lubricant.

Frosting and Whitening of Silver Goods, Pickle for.

1.—Sulphuric acid, 1½ dr.; water, 6 oz. Heat, and immerse the silver until frosted as desired. Wash well, dry with a soft linen cloth or in fine sawdust. For whitening only, use less acid.

2.—*Polished Silver.*—Make a solution of ½ oz. of cyanide of potassium in ¼ pt. of water. Apply to the silver with a brush. Hold the silver with pliers made of lancewood or boxwood. Very poisonous.

Gilding.

1.—Dissolve equal parts, by weight, of bichloride of mercury (corrosive sublimate and chloride of ammonium (sal ammoniac) in nitric acid; now add some grain gold to the mixture, and evaporate the liquid to half its bulk; apply while hot to the surface of the silver article.

2.—A rich gold tint may be imparted to silver articles by plunging them into dilute sulphuric acid saturated with iron rust.

3.—*Water Gilding.*—Pour strong vinegar on copper flakes; add alum and salt in equal quantities; set on a fire, and when the vinegar has boiled until it becomes ¼ part its original quantity throw into it the metal you design to gild, and it will assume a copper color. Continue boiling, and it will change into a fine gold color.

Oxidizing.

1.—Add four or five thousandths of ammonium sulphide or potassium sulphide to water at a temperature of 160 to 180° F. When the articles are dipped into this solution an iridescent coating of silver sulphide is produced, which, after a few seconds, turns blue black if allowed to remain in the liquid. Remove, rinse, scratch-brush, and burnish when desired.

2.—There are two distinct shades in use, one produced by a chloride, which has a brownish tint, and the other by sulphur, which has a bluish-black tint. To produce the former it is only necessary to wash the article with a solution of sal ammoniac (ammonium chloride).

3.—A much more beautiful tint may be obtained by employing a solution composed of equal parts of copper sulphate and ammonium chloride in vinegar (or dilute acetic acid). The fine black tint may be produced by a slightly warm solution of sodium or potassium sulphide.

4.—Bromine, 5 gr.; potassium bromide, 5 dwt.; water, 10 oz.; boil the silver in this usually 2 to 5 minutes, then polish with rouge.

5.—Dissolve sulphate of copper, 2 dwts.; nitrate of potash, 1 dwt.; ammonium chloride, 2 dwts., in a little acetic acid. Warm the article and apply the solution with a camel's-hair pencil and expose to the fumes of sulphur in a closed box. Parts not to be colored must be coated with wax.

6.—Dip the clean silver article in a solution of sulphide of potassium (liver of sulphur), 2 dr. to 1 pt. of water. Heat this solution to a temperature of 175° F. Immerse for a few seconds only, when the article becomes blue black. For a velvet black, dip the article, previous to oxidizing, in a solution of mercurous nitrate and water, and rinse. Then dip in the sulphide solution as above. For a brown shade, oxidize in the potassium sulphide as above, then dip in a liquid composed of 10 parts of blue vitriol and 5 parts of sal ammoniac to 100 parts of vinegar. After oxidation, brush with a scratch brush very lightly, to brighten and variegate the surface. There are many other methods, among which will be found the following:

7.—Expose to the vapor of chlorine.

8.—Use a solution of equal parts of copper sulphate and ammonium chloride dissolved in vinegar.

9.—Potassium sulphide dissolved in warm water.

10.—Sodium sulphide dissolved in warm water.

11.—Wash with a solution of ammonium chloride.

Platinizing.

Place some platinum in a small quantity of aqua regia or nitrohydrochloric acid, and keep it in a warm place for a few days, when it will have dissolved. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and hydrochloric acids. Add a little water, and it is ready for use. A dozen drops of this solution goes a long way in platinizing silver. The operation is performed in a small glass or beaker, covered with a watch glass to keep in the fumes, and placed in a little sand in a saucer to equalize the heat.

Red.

A solution containing 9.72 grams of uranium nitrate in 1,130 grams of water is mixed with a solution of potassium ferrocyanide of the same concentration. When the solution is to be used, 283 grams of acetic acid and 2 liters 268 grams of water are added, the mixture is warmed, and the silver immersed; a deep red color develops on the surface of the latter.

Rose.

Immerse for a few seconds in a concentrated hot solution of copper chloride; rinse, dry, and immerse in alcohol; finally, dry off by holding near the fire.

Slate Gray.

Make a solution of 35.4 grams of iodine and 345.4 grams of potassium iodide in ½ l. of water.

ZINC

Blacking.

1.—Chloride of platinum, painted on zinc, gives a very dead black.

2.—Zinc may be given a fine black color, according to Knaffl, by cleaning its surface with sand and sulphuric acid and immersing for an instant in a solution composed of 4 parts of sulphate of nickel and ammonia in 40 parts of water, acidulated with 1 part of sulphuric acid, washing, and drying it. The black coating adheres firmly, and takes a bronze color under the burnisher. Brass may be stained black with a liquid containing 2 parts of arsenious acid, 4 parts of hydrochloric acid and 1 part of sulphuric acid, in 80 parts of water.

3.—A weak solution of sulphate of copper, and then with a decoction of logwood.

4.—Clean the zinc by dipping in an acid; rinse, and plunge into the following: Nickel ammonium sulphide, 4 parts; sulphuric acid, 1 part; water, 40 parts. Mix. Wash the article, and dry carefully.

5.—Treat with an acidulated solution of antimony chloride, thus: Hydrochloric acid, 6 parts; antimony chloride, 10 parts; alcohol, 100 parts. Mix. When the desired shade is attained, dry, and rub with some good drying oil. Give 2 or 3 coats.

Bronzing.

1.—Mix thoroughly 30 parts of sal ammoniac, 10 parts of oxalate of potash and 1,000 parts of vinegar. Apply with a brush or a rag several times until the desired tint is produced.

2.—Puscher employs acetate of lead for this purpose. On apply this substance, mixed with a minium preparation, a reddish brown tinge is obtained. The cupola of the synagogue at Nuremberg was thus colored, as an experiment, a long time ago, and to all appearance is yet unaffected by the weather. By adding other bases lighter or darker tints of gray and yellow may be obtained, giving the zinc work the appearance of carved stone. With a solution of chlorate of copper the preparation turns the sheets of zinc.

3.—First give a coat of brass (see ELECTROMETALLURGY). Then wet with a cloth dipped in copper protochloride dissolved in hydrochloric acid. When dry, brush with a mixture of equal parts of iron peroxide and plumbago mixed up with a little essence of turpentine. Varnish with thin copal varnish.

Green Patina.

1.—Make the following solution: Sodium hyposulphite, 2 parts; sulphuric acid, 1 part; water, 20 parts. Mix; filter off the precipitated sulphur, and heat the filtrate. Plunge the object into the hot solution; watch the coloration as it progress, and when the desired tint is secured removed, let dry, and varnish with copal.

2.—*Zinc Roofs.*—Cleanse the zinc of all dirt, and coat it repeatedly with a diluted solution of copper nitrate. When the whole roof has been coppered over, cover it with a likewise diluted solution of carbonate of ammonia. On this coat of copper patina readily forms.

Bronzing for Zinc, by Simple Immersion

Water.	Nitrate of iron.	Protochloride of tin.	Sulphate of copper.	Ferrous chloride.	Lead chloride.	Pearlash.	Sulphocyanide of potassium.	Hyposulphite of soda.	Garancine infusion.	Logwood infusion.	
pt.	dr.	dr.	dr.	dr.	oz.	oz.	dr.	dr.			
1	5	.	..	..	..	..	..	..	..	..	Black.
1	..	1	..	..	..	..	..	..	..	..	Black.
1	..	1	..	..	..	..	1	..	..	..	Dark gray.
2	..	..	1	1	..	..	..	..	..	..	Dark gray.
..	..	..	..	..	×*	..	..	..	..	..	Dark gray.
2	..	..	..	1	..	..	..	..		..	Green gray.
.	..	..	..	..	..	..	..	..	×	..	Red—Boil.
1	..	..	4	..	..	4	..	..	..	..	Copper color. Plates so c Λ z.
1	..	..	8	..	..	..	..	8	..	..	Copper color, with agitation.
..	..	..	..	..	..	..	..	..	..	×	Purple—Boil.

* Made to the consistency of cream.

CHAPTER IX

DYEING

DYEING

Simple directions for dyeing textiles will be found at the end of the chapter. Dyeing is a business, and can hardly be learned from formulas, hence the inclusion of any great number has been avoided as taking up valuable space.

Bristles, To Dye.

Steep them for a short time in any of the common dyes used for cotton or wool.

Celluloid.

Black.—The object is first dipped in weak lye, then in a weak solution of nitrate of silver, and allowed to dry exposed to the light.

Blue.—For this use an indigo solution, almost neutralized with potash; also Berlin blue solution; also, on the one hand, chloride of iron solution, and on the other ferrocyanide of potassium solution.

Brown.—Use a solution of permanganate of potash made alkaline with soda.

Green.—Place the object in a solution of 2 parts of verdigris and 1 part of chloride of ammonia.

Purple.—Immerse the object in dilute solution of chloride of gold, and then expose to strong light.

Red.—Immerse the object first in water weakly acidulated with nitric acid, then in ammoniacal cochineal or carmine solution.

Yellow.—Immerse the object first in a solution of nitrate of lead and then in a solution of yellow chromate of potash.

Easter Egg Dyes.

Blue.—Marine blue, B. N. (aniline colors), 30 gr.; citric acid, 250 gr.; dextrine, 1 oz.

Brown.—Vesuvin, S., ½ av.oz.; citric acid, ½ av.oz.; dextrine, ½ av.oz.

Green.—Brilliant Green, O., 200 gr.; citric acid, 250 gr.; dextrine, 2 oz.

Orange.—Orange, II, 125 gr.; citric acid, 250 gr.; dextrine, 2 oz.

Red.—Diamond, fuchsin, I, small crystals, 25 gr.; citric acid, 125 gr.; dextrine, 1 oz.

Rose.—Eosin, A., 50 gr.; dextrine, 2 av.oz.

Violet.—Methyl violet, 6B, 30 gr.; citric acid, 150 gr.; dextrine, 1 oz.

Yellow.—Napthol, yellow, S., 200 gr.; citric acid, 500 gr.; dextrine, 2 oz.

To use, dissolve the dye in an earthen vessel, in 1 pt. of boiling water; stir until solution is completed. In the meantime, boil 5 well washed eggs in water for 5 minutes, then transfer them to the dye, and allow to remain until sufficiently colored, turning them occasionally. Dry with a soft cloth, and rub with oil until they appear glossy.

Feathers.

In general terms, clean with carbonate of ammonia, wash, and steep overnight in a solution of nitrate of iron 7° B.; then rinse in water. Boil out equal parts of logwood and quercitron, and immerse the feathers at a "hand heat." When black, remove, and wash in warm water. Dissolve 3½ oz. of bicarbonate of potash in 5 qt. of hot water and stir in 17½ oz. of olive oil; shake until it becomes an emulsion. As before, at a gentle heat, immerse in this, draw out the surplus moisture between the finger and thumb, and dry over a stove, constantly shaking them. Experience and skill are necessary.

Black.—1.—The feathers should be soaked in a solution of ammonium of sodium carbonate, whereby they are rendered less liable to break or bend; after being dyed they should be dried in a current of warm air. Feathers may be dyed black in the following baths: (a) Water, 100 pt.; ignited sodium carbonate, 1 lb. (b) Ferric nitrate at 70° B. (c) Logwood, 2 lb.; quercitrine, 2 lb. Half a pound of feathers is digested in (a) at 30°; the feathers are then washed with warm water and soaked in (b). After another washing they are boiled in (c) until of a deep black color; they are then dipped in an emulsion formed by agitating oil and potassium carbonate together, and dried by gently swinging them in warm air.

2.—By immersion for 2 or 3 days in a bath (at first hot) of logwood, 8 parts, and copperas or acetate of iron, about 1 part.

Bronze.—Fashion has introduced gilded and silvered feathers. It is chiefly goose feathers and wings of pigeons which appear covered with gold and silver. The process is very simple. The feather is dipped in bronze powder and rubbed with a piece of wash leather. In course of wearing, however, the bronze is very easily detached. To prevent this, the feather, before being dipped in the bronze powder, is taken through gum water, pressed nearly dry between cloths, and in its slightly adhesive state is treated with bronze powder. Partially bronzed feathers and wings are produced by covering those parts which are to remain plain with pasteboard, and the bronze powder is rubbed upon the rest with a feather. Of course, varied effects may be produced by dyeing the feathers with aniline colors, etc., prior to the application of the bronze.

Crimson.—A mordant of alum, followed by a hot bath of Brazil wood, and afterward by a weak one of cudbear.

Brown.—Feathers may be dyed brown by first treating them with catechu and then with potassium chromate; they can be dyed directly with aniline colors, and can be bronzed by painting with aniline violet dissolved in alcohol at 90%.

Gray.—1.—Felt gray is a yellowish gray. It consists in employing felt gray in connection with rose-colored gray. These two substances, of easy application, will serve for the generality of the tents in question. If it were required to produce a somewhat roseate hue, cochineal or violet might be taken: if, on the contrary, a green one, a very small quantity of indigo-carmine would be required. These coloring substances are applied, according to the feather and the tone of the color, in a cold, lukewarm or boiling-hot bath, acidulated with acetic acid or salt of sorrel.

2.—Giselle gray is a mixture of white with black. It is easily obtained by dyeing the feather with a small quantity of gloss black. As there is always a residue of yellowish hue, it becomes necessary to give it a rose color with cochineal. This operation is effected in a cold bath acidulated with a small quantity of potassium binoxalate. If it be an ostrich feather, starch is dissolved in it.

3.—Iron Gray, Steel Gray, etc.—These kinds of gray are usually rather darkish; the tints result from a mixture of blue a good deal of black, and some white. They are obtained on the feather by means of a conveniently proportioned mixture of roseate gray and blue gray, the shade being subsequently imparted as in the case of the other gray species.

Pink or Rose.—With safflower and lemon juice.

Plum.—1.—The red dye, followed by alkaline bath.

2.—The plum color is a pale violet. The feather is dyed in a bath acidulated with sulphuric acid, archil, indigo-carmine and black gloss, so that an almost black garnet may be produced. It is well to add a little lilac. The feather is taken out of the bath only at this moment. It is rinsed in pure water and then given a violet tint in a more or less heated solution of carbonate of soda. During this operation the archil turns from red to violet. Black is developed, and settles more firmly on the feather, while a large portion of the indigo-carmine goes off. It is a primitive process, and certainly not economical, but which, nevertheless, gives good results in skilled hands; but in the hands of unskilled operators it is extremely tiresome and of doubtful success.

Red.—A mordant of alum, followed by a hot Brazil wood bath.

Yellow.—An alum mordant, followed by a bath or turmeric or weld. Other shades may be obtained by a mixture of the above dyes. Feathers may also be dyed by simple immersion for 2 or 3 minutes in a bath of any of the aniline colors.

Gloves.

Kid gloves of good quality, especially when light colored, are often thrown away when soiled, and made no further use of. By employing the following simple means they might easily be dyed violet, black or yellow, by the owner himself, and made to look almost equal to new. The gloves are first soaked in a little hot water containing dissolved crystals of soda or potash, whichever color may be desired, and after a 25-minute bath they are taken out, washed, rinsed, and wrung. When the gloves are thus cleaned they are stretched tightly over a wooden hand and the dye applied.

The aniline colors can be employed without any previous preparation of the leather. The bluish tint so greatly liked in black gloves is obtained by washing the finished article with sal ammoniac solution. If it is required to keep the seams white, they are covered with flour paste with which some fat has been admixed. Instead of brushes, one may sometimes use a sponge.

Black.—The glove is washed in alcohol, and three times brushed over with a decoction of logwood, allowing between each brushing 10 minutes for drying; afterward dipped into a solution of iron protosulphate, and then brushed with warm water. Should the color not prove sufficiently dark, a decoction of quercitron may be added to the logwood decoction. Instead of the protosulphate some nitrate of iron may be used. As the leather begins to dry it is rubbed over with the talc powder and some olive oil, and pressed between flannel. The treatment with talc and oil is repeated, and the glove then allowed to dry on the stretchwood.

Brown.—The solution is made of varying quantities of decoctions of logwood and Guinea wood. For darkening, a small quantity of iron protosulphate is employed.

Gray.—Brushing with a decoction of sumac, and subsequent treatment with a feeble solution of iron protosulphate. The addition of logwood and yellow Brazil wood to the sumac decoction produces a greenish gray tint.

Modes and Grays.—Clean with soap in the usual manner, and after they have been brushed with water brush over with the following mixture at 104° F.: Logwood, 45 gr.; orchil, 8¾ oz.; water, 1¾ pt. Boil. A second bath is prepared of 30 gr. of nitrate of iron in 35 oz. of water, and is applied with the brush, to produce a gray tone.

Orange Yellow.—Simple decoction of onion peel is said to produce upon glove leather an orange yellow superior in luster to any other. It is also said to be suitable for mixing with light bark shades, especially willow bark, and as a yellow for modulating browns. The onion dye is said to fix itself readily, even upon leathers which resist colors, and colors them well and evenly.

Russia Red.—Decoction of cochineal with a tin salt and some saccharic acid; and if a dark tint is demanded, the addition of some logwood extract.

Straw.—After cleaning, as in white, and rinsing well in water, two baths are prepared: (1) a bath of soda at ½° B. (2) A bath of nitrate of iron at the same strength. The gloves are brushed first with (1), then dried, and brushed with (2), and finally with water, and dried at a gentle heat. They are then finished with the following mixture: Yolk of egg, 155 gr.; glycerine, 77 gr.; water, 1¾ pt. When half dried they are rubbed with clean flannel.

Violet.—According to the tint desired, aniline or orseille violet must be used. Apply a little of the color by means of a brush or rag dipped in the coloring liquid. Lay on several coats of alum dissolved in water, then dry. Then apply 1 or 2 layers of the dye, which must be always hot. The kid is polished before finally drying, with a pad made of cork, covered with a piece of woolen cloth. This is the best way of regaining the gloss.

White.—The gloves are placed on a wooden hand and then brushed over with a soft paint brush steeped in curd soap, 155 gr.; milk, 35 fl.oz. They are then dusted over with fine Venice talc, and rubbed with a bit of clean flannel. If this process does not leave them white enough, it is recommended.

Yellow.—This requires a less complicated process—a decoction of Avignon crystals with alum. Apply several layers, and polish the kid in the way indicated above.

Gutta Percha.

After dissolving 2 oz. of gutta percha in chloroform add 1 gr. of pure carmine, dissolved in a little pulverized gum and water. After the chloroform is distilled off the gutta percha is to be thoroughly kneaded. Anything may be used in this way, according to the color required, such as ocher, ultramarine, etc.

Hats.

Brown.—1.—Bismarck Brown on Felt Hats (50 hats).—Prepare with soda, as formerly directed, and boil for 45 minutes with 22 lb. of fustic, 10½ oz. of logwood, 3¼ lb. of sumac, 8¾ lb. of sanders and 17¼ oz. of argol. Boil for 2 hours, and add 2 lb. 3 oz. of bluestone and 7 oz. of copperas. Re-enter the hats, and boil for ¾ hour longer.

2.—Brown on Mixed Hats (5 doz.).—Prepare with soda, and boil for 2 hours with 22 lb. of fustic, 5 lb. 7 oz. of madder, 25¾ oz. of turmeric, 2 lb. 3 oz. of madder, 25¾ oz. of sanders and 17¼ oz. of argol. Air the hats and add 17½ fl.oz. of black liquor and 2¼ oz. of copperas. Re-enter the hats, and boil again for an hour.

3.—Chrome Brown on Felt Hats (50 hats).—Prepare with 4¾ oz. of chromate of potash, 14 oz. of argol and 17½ fl.oz. of a solution of tin. Let the hats lie overnight in the flot, and dye the next morning in fresh water with 17¼ oz. of young fustic, 26 oz. of fustic, 17¼ oz. of turmeric, 6 lb. 9 oz. of madder, 3 lb. 4 oz. of peachwood and 7 oz. of logwood.

4.—Cinnamon.—Red lead, 3½ lb.; best terra castle, 2½ lb.; picric acid, 2½ oz.; indigo extract, ½ gill; orchil, 3 pt. The picric acid is first dissolved in hot water, and the other ingredients are added (See also STRAW DYEING, below.)

Cream Color.—(24 doz. 3-oz. bodies.)—Red lead, 2 lb.; common terra cotta, 2 lb.; indigo extract in liquor, 2 gills; orchil, 3 gills.

Fawn Color.—Burnt sienna, ground fine, 1½ lb.; burnt umber, ¾ lb.; orchil, ¼ gill; indigo extract in liquor, ¼ gill.

Gray.—An ordinary drab for soft hats: Common graphite, ¾ lb.; best graphite, ¾ lb.; orchil, 3 gills; indigo extract, 2 gills. Put the graphite into a pan, cover with water, and let down with sulphuric acid at 30° Tw.

Mouse Color.—Common graphite (black lead), 3½ lb.; best terra castle, 2½ lb.; indigo extract in liquor, 2½ gills; orchil, 4 gills; red lead, 8 oz.

Rose.—Common graphite, 2¾ lb.; indigo extract in liquor, 2 gills; orchil, 5 gills.

Slate.—Common graphite, 4 lb.; indigo extract, 4 gills; orchil, 3½ gills.

Horsehair.

The horsehair is first washed in soap, and rinsed.

Blue.—1.—The hair is mordanted in a solution of 2 parts of alum and 1 part of tartar, rinsed, and dyed in a solution of sulphate of indigo, then washed and dried.

2.—Violet shade.—Treated as described in brown, then passed through water to which a little chloride of tin solution has been added.

Brown.—Obtained by letting lie for 12 hours in a decoction of logwood and limewater at 120° F.

Red.—The hair is first laid down for 1½ hours in a solution of chloride of tin, and then prepared as blue, violet shade; after rinsing it is dyed with Brazil wood and alum, allowed to lie in the bath 24 hours, washed, and dried.

Pasteboard.

To color white pasteboard the color of leather, soak in a solution of copperas and then in ammonia.

Straw.

Black.—1.—In order to obtain a level color a solution of gluten is added to a lye of soda, which is allowed to stand for 24 hours and filtered. The hats are then steeped for 12 hours in the clear liquid. The straw is thus freed from grease, and the mordants of nitrate, sulphate, or acetate of iron, as well as the decoction of logwood, mixed with sumac or galls, is very evenly taken up by the fiber. A slight addition of bichromate of potash improves the tone of the dye, and the goods are finished with gum or gelatine.

2—For 11 lb. of hats: Copperas, 2 lb. 3 oz.; red argol, 1 lb. 1½ oz.; bluestone, 17¼ oz. If possible, steep the hats overnight in an old black dye beck, and dye up the next morning in fresh water with about 4 lb. 6 oz. of good logwood and a little turmeric. The hats thus dyed appear, at first, rather brownish, but they assume a fine black luster on brushing.

3.—The hats are first steeped in a beck of soda at 5° Baume at the heat of 122° F., for 3 hours, rinsed, and soaked overnight in a sumac beck containing 2¼ lb. of sumac per 5 hats. In the morning take out and drain, and soak for 3 hours in a cold beck of black liquor at 2° B. Take out, drain, and lay the hats separately to air for 6 hours; rinse, and dye at 144° F., with 2¼ lb. of logwood per 11 lb. of hats, till the shade is reached. Lift, drain, dip singly in a lukewarm beck containing 8¾ oz. of glue per 17 pt. of water; dry, and rub with a hard brush.

Bleaching and Dyeing.—Put the straw hats into a pan of boiling water and let them steep overnight. The next morning make up a strong soap beck and brush them well therein. Put them in the stove, without rinsing, for 24 hours, then rinse and dry.

Brown (11 lb.).—1.—Boil for 2 hours with 4 lb. 6 oz. of fustic, 3¾ lb. of orchil, 1¾ oz. of argol, and the same weight of logwood.

2.—Boil for an hour in the solution of 3¼ lb. of catechu, drain, and work in a fresh beck made up of 2 lb. 3 oz. of copperas, and rinse.

3.—Catechu Brown.—For 11 lb. of hats: Boil with sulphate of alumina, 17¼ oz.; bisulphate of soda, 8¾ oz.; oil of vitriol, 4⅝ oz. Add to the bath orchil, indigo, carmine and turmeric, according to shade, and boil.

Gray.—For 11 lb. of hats: For iron gray, steep in a decoction of sumac, and dye cold in a beck made up with benzoline and a little acetic acid. There are three sorts of benzoline, so that the tone of the gray may be varied at will. These benzoline grays are much brighter than those obtained with the old processes.

Green.—Straw is placed in boiling water, then well washed with cold water, and bleached in a bath containing 20 gr. of bleaching powder to 7 or 9 gr. of sulphuric acid. It is then thoroughly washed and mordanted with sumac, alum and tartaric acid (not too dilute a liquor). Finally, it is dyed with aniline green and picric acid until the required shade is obtained, after digesting for some time.

Magenta Red.—The first operation for dyeing this or any other color on straw is to steep the latter in a bath acidulated with sulphuric acid, for 12 hours. For magenta, take an acid bath of 4 to 5° Be. The straw, after washing, is immersed for 12 hours in a bath kept at 30 to 40° C., containing the necessary amount of dye. Now wash well, and dry. Other aniline colors do not dye straw with the same facility.

Maroon, with Logwood.—Clean the straw by boiling with a solution of carbonate of soda, then steep in a bath of logwood for 2 hours. To give a bluish tint, add some bluestone to the bath; if too much of the latter is used the straw will have a greenish hue. This is a loose color, only employed on account of its cheapness.

Yellow.—To produce the yellow shade, which is in such demand, give them a bath with a little picric acid soured with a little oil of vitriol, and let them dry on the block. For a gloss, rinse in gum arabic water or water in which gelatine has been soaked.

Textiles.

Simple Dyes for Home Use.—The following are specially intended for those living in isolated districts, where special dyes and dyeing materials are practically unavailable. First it may be stated that in almost every case a fixing material or fluid is required, this being usually termed a mordant. The common rule is to use alum for fixing ordinary reds, blues, yellows and greens, ¼ lb. of alum to 2 gal. of boiling water. For deeper colors, such as black, purple, violet, and the heavy browns, acetate of iron is used. For scarlets and brilliant reds of this shade "tin liquor," or muriate of tin, is required. To make this, obtain some tin filings (or pour some molten tin into cold water from a height of about 6 ft., which will reduce it to small particles). When dried, put the tin in a bottle, pour in 12 oz. of muriatic acid (known also as spirits of salts), then add, a little at a time, 8 oz. of sulphuric acid. The latter must be added slowly, or the heat will break the bottle. When ebullition has ceased, stopper the bottle and let it stand a day. It will keep good for a year or more. This mordant can often be obtained already prepared at a druggist's, with directions for use. As previously stated in this chapter, all goods to be dyed must be washed perfectly clean, all grease, or size, or "dress," being removed. Failing this, the work will finish patchy or spotty. After dyeing goods, they should be dried, or at least well aired, before washing out the superfluous dye. Silk and merino dresses should not be wrung. When hanging to dry, let all shawls and dress goods be fastened up by their edges, so as to dry evenly.

Whenever using logwood chips as a dye, boil them for ½ hour; or, to hasten matters, they may be tied up loosely in a bag, and be boiled with the goods (though it is not so good a plan); or the extract may be used, 2½ oz. of this being equal to 1 lb. of chips.

Woolen Goods.—Black.—Prepare a mordant of copperas, ¼ lb. to 2 gal. of water, boiled together. (This is also known as green vitriol; blue vitriol may also be used.) While boiling, dip the goods for about 40 minutes, airing them between; or the goods may be boiled in the solution for 15 minutes, which is quicker, but not quite so good. Have ready a dye made by boiling 2 lb. of logwood chips for ½ hour. Immerse the goods in the boiling dye for 1 hour, then air, and immerse again for ½ hour; or the goods may be boiled in the dye for 1 hour. Dry thoroughly, and afterward wash in suds to remove superfluous dye. Rinse, and then press or iron out, using a damp linen sheet between the iron and the dyed goods.

Blue.—1.—For 1 lb. of goods: Alum, 2½ oz.; cream of tartar, 1½ oz.; water. Boil together, then boil the goods in it for an hour. Prepare some warm water with indigo extract in it to the color desired, and boil up. Add more indigo if desired.

2.—Boil together 2 gal. of water, 2 lb. of logwood chips, ½ oz. of Brazil wood and ½ lb. of green vitriol (copperas). Strain clear of the chips, then boil the goods in the liquor.

Green.—For 1 lb. of goods: Fustic, 1 lb.; alum, 3½ oz.; water. Steep until most of the strength is extracted, then soak the goods until a good yellow is obtained. Remove the fustic, and add extract of indigo (also known as chemic), a very little at a time, until the desired green is obtained.

Indigo Extract.—This is used for a blue coloring, and is made as follows: Take 1 oz. of finely ground indigo and stir it into ¼ lb. of oil of vitriol, and stir for

30 minutes. Cover over, and let it remain for 2 or 3 days, giving it a stir occasionally. Then stir in ¼ teaspoonful, or less, of carbonate of soda to neutralize the acid. Store in a glass bottle, and it will keep well. It can often be obtained ready prepared at druggists.

Madder Red.—For 1 lb. of goods: Alum, 5 oz.; cream of tartar, 1 oz.; water. Boil together, then put in the goods, and boil for ½ hour. Take them out to air for a little time, and boil for ½ hour longer. Now, in another pan put sufficient bran to half fill it, and then fill up with water. Make it slightly warm, and let it stand until the bran rises. Skim off the bran and put in ½ lb. of madder. Put in the goods, and boil up slowly. When the water boils the dyeing is finished. Wash in suds.

Pink.—The same quantity of cochineal and cream of tartar, but no tin liquor. First boil 1 lb. of alum in water for the mordant, and dip the goods in this for 1 hour, then follow with the dye.

Scarlet.—For 2 lb. of goods: Well pulverized cochineal, 1 oz.; cream of tartar, 1 oz.; tin liquor, water, 5 oz. Boil together, then put in the goods, working them about for 10 minutes, afterward boiling for 1 hour. Stir occasionally when boiling. Finally, wash in clear water, and either finish as described with black, or dry in the shade.

Snuff Brown.—For 1 lb. of goods: Camwood, 4 oz.; boil this for 20 minutes. Dip the goods for ¾ hour; remove goods, and add to the liquor ½ lb. of fustic. Boil for ¼ hour, and dip the goods again for ¾ hour. Remove goods, and add ¼ oz. of blue vitriol and 1 oz. of green vitriol (copperas). Boil up, and dip again for ½ hour. More green vitriol will darken the color. It is permanent.

Cotton and Linen Woven Goods.—In all cases, cotton or linen goods should be boiled in strong soapsuds or weak lye, to make them clean, the suds or lye being then carefully rinsed out with clear water.

Black.—Some trouble is always necessary to get a permanent black on cotton goods. For 1 lb. of goods. Take ½ lb. of sumach (wood and bark together), and boil ½ hour. Let the goods steep in the liquor 12 hours. Dip in limewater for ½ hour. Add to the sumach liquor 1½ oz. of copperas, and dip for another hour. Dip in limewater again for ¼ hour. Make a dye of ½ lb. of logwood chips, boiled for 1 hour, and dip the goods in this liquor for 3 hours. Add ½ oz. of bichromate of potash to the logwood dye, and finally dip for 1 hour. Wash in clear water and dry in the shade.

Blue.—1.—Boil together 2 gal. of water, 2 oz. of sulphate of indigo and ¼ lb. of potash. Dip the goods, and let them lie in this for a day and a night. Wring out, and dip in a fixing bath of ¼ lb. of alum dissolved in 2 gal. of boiling water. Let the goods be in this bath for 3 hours. The goods are best hung to dry in open light, as the color is improved by this.

2.—First steep the goods in an alum fixing solution, then dye in a liquor composed of ¼ lb. of chemical blue to 2 gal. of water. Let the goods be in the dye a day and a night.

3.—For cotton, 5 lb., or linen, 3 lb.: Bichromate of potash, ¾ lb., dissolved in boiling water; put in the goods, and dip 2 hours; then take out and rinse. Make a dye with logwood, 4 lb.; dip in this 1 hour, air, and let stand in the dye 3 or 4 hours, or till the dye is almost cold; wash out, and dry.

4.—Sky Blue.—For 1 lb. of goods: Blue vitriol, 1½ oz.; water. Dissolve by boiling. Dip the goods 3 hours and then pass them through lime water.

Brown.—A very good brown is obtained by dyeing for sky blue as last explained, then passing the goods through a solution of prussiate of potash.

Buff.—Boil together 3 gal. of water, ¼ lb. of annatto and ½ lb. of potash, stirring well. Put the goods in this and let boil for 10 minutes. Stir well all the time. Remove the goods, and put them direct into cold clear water, and rinse. Hang out to dry without wringing.

Green.—1.—Dip the cotton in the home-made blue dye tub until blue enough to make the green as dark as required; take out, dry, and rinse the goods a little. Make a dye with fustic, ¾ lb.; logwood, 3 oz. to each lb. of goods, boiling these 1 hour. When cooled to bear the hand, put in the goods, move briskly a few minutes, and let lie 1 hour; take out and let thoroughly drain. Dissolve, and add to the dye, for each lb. of cotton, ½ oz. of blue vitriol, and dip another hour; wring out, and let dry in the shade. By varying the quantity of logwood and fustic, any shade of green may be obtained.

2.—For cotton or linen. First boil the goods in a fixing solution of alum and water, then make a dye of 2 gal. of water with 2 oz. of indigo and 2 oz. of turmeric. Boil the goods in this until the desired tint is obtained.

Yellow.—First boil the goods in a fixing solution of alum and water, then boil in a dye made of annatto or turmeric, boiled in water.

Silk Goods.—These must first be washed clean, so as to remove all grease or "finish," as failing this, the dye may not take evenly, and cause much disappointment.

Black.—Take 2 gal. of vinegar and boil with 2 lb. of copperas, 2 lb. of logwood chips and 2 oz. of nutgalls (bruised). Let the mixture boil 30 minutes (until it is dark). Drain off the liquor, and boil the goods in this until they are the shade desired. Rinse in clear water, and dry.

Blue.—1.—Prepare a fixing bath of 1 lb. of copperas boiled in 1 gal. of water, and dip the goods in this. Make a dye bath of 1 gal. of water, 3 oz. of alum, and sufficient indigo extract or chemic (already described). The indigo extract must be added in very small quantities at a time until the right shade is obtained. The more of this that is used the darker the goods will be.

2.—Sky Blue.—Follow the first part of the process for cinnamon brown, just explained.

Brown.—1.—Cinnamon. Prepare a solution by boiling 2 oz. of blue vitriol in 1 gal. of water. Dip the goods for 15 minutes, then run them through limewater. Dip the goods in a solution of 1 oz. of prussiate of potash to 1 gal. of water. The first dipping will make the goods bright blue, while the latter will change it to brown.

2.—If the goods are boiled in a decoction of the peels of green walnuts, a good brown will be obtained.

3.—Reddish Brown.—Boil the goods in a liquor made by boiling oak mark in water.

Crimson.—For 1 lb. of goods: Dip the goods in an alum fixing bath, then in a dye bath of cochineal, 3 oz.; nutgalls, bruised, 2 oz.; cream of tartar, ¼ oz.; water, 1½ gal. Boil together 10 minutes, then allow to cool. When a little cool put in the goods, boil up, and keep it at this for 1 hour.

Yellow.—1.—For 1 lb. of goods: Make an alum fixing bath, and add ¾ oz. of sugar of lead to it. Let the goods be in this 12 hours, then take out and drain. Make a dye with 1 lb. of fustic, and dip the goods until the required color is obtained.

2.—For 1 lb. ·of goods; Take ½ lb. of yellow oak bark and boil for ½ hour; strain off the liquor and add 6 oz. of alum. Dip in this.

CHAPTER X

ELECTROMETALLURGY AND HOT AND COLD COATING OF METALS

PRELIMINARY TREATMENT

Electrometallurgy has two departments, which are distinguished by the preparation of the surfaces to be coated.

Electroplating is the production of adhesive deposits, and depends on the absolute cleanness of the metal surface coated. This will be treated first.

Electrotyping is the production of removable deposits from either non-metallic molds or from metal surfaces, whose cleanness is destroyed either by black-leading or by rubbing with turpentine containing a trace of wax. The preparation of the objects depends (1) upon the class of deposit required; (2) upon the nature of the object itself. In all cases, ordinary dirt, rust, etc., must be removed, as the deposit reproduces every feature of the surface, even to a finger mark.

Cleansing.

1.—Copper, brass, zinc and the noble metals are cleaned by the suitable acids which act on them. Such cleaning solutions may be prepared for different metals as follows:

	Water.	Nitric.	Sulphuric.	Hydrochloric.
For copper and brass	100	50	100	2
Iron	100	3	8	2
Iron (cast)	100	3	12	3
Zinc	100		10	..
Silver	100	10	..	..

It is best to make two such solutions, one being reserved for a final dip, during which a strong action occurs upon the surface. As this becomes weaker it can be used for the first cleansing, accompanied by occasional rubbing with sand, etc., according to the nature of the object.

Lead, tin and pewter must not be placed in acid, but are cleaned by aid of caustic soda.

Objects must be carefully freed from acids if they are to be transferred to silver or gold solutions, but less care is necessary for objects cleaned in soda, nor is the same care necessary in transferring objects cleaned in acids to an acid coppering solution. In such cases the best plan is to dip into clean water and at once transfer to the depositing cell.

2.—Cleansing and Preparing Objects for Electroplating.—The first and most important operation in the electro-deposition of one metal upon another is to effect a thorough chemical cleansing of the surface of the metal upon which the coating is to be deposited, for if this is not accomplished the deposited metal will not adhere to the surface.

In cleansing, different metals usually require a somewhat different treatment. The surface of most metals, when clean, soon becomes coated with a film of exide when exposed to the air, especially when the surface exposed is wet, and to avoid this it is usually necessary to proceed with the plating immediately after cleansing.

Before proceeding to cleanse the articles they are usually "trussed" with copper wire to avoid the necessity of handling them during the operation or afterward, until the plating is finished. A very slight contact with the hand is often sufficient to make a second cleansing necessary.

If the article to be plated presents a smooth, finished or polished surface, the deposit will be "bright." If, on the contrary, the surface is rough or unpolished, the deposit will ordinarily have a dead luster. If left too long in the acid dips used in cleansing, the polished surface is apt to have its finish deadened. No interval should be allowed between the various operations of cleansing.

Copper and Copper Alloys.—Caustic potash, 1 lb.; soft water, 1 gal. Heat nearly to boiling in a cast-iron pot provided with a cover. Brush to remove any loosely adhering foreign matters.

truss, and suspend for a time in the hot lye; usually, a few minutes will suffice if the article is not heavily lacquered. If any of its parts are joined with solder it should not be allowed to remain too long immersed, as the caustic liquid attacks solders, and their solution blackens copper. On removing, rinse thoroughly in running water. If the articles are much oxidized, pickle in a bath composed of 1 gal. of water and 1 pt. of sulphuric acid until the darker portion is removed. Rinse in running water, and dip in the following solution: Soft water, 1 gal.; cyanide of potassium, common, 8 oz. Remove from the bath and quickly go over every part with a brush and fine pumice stone powder moistened with the cyanide solution. Some electroplaters prefer to give the articles a preliminary "brightening" dip in nitric acid, or a mixture of nitric and sulphuric acids and salt, followed by rinsing in water, but the cyanide, aided by the mechanical action of the pumice and brush, does very well without it in most cases. After the scouring, dip the work momentarily in the cyanide solution, rinse quickly in running water, and transfer immediately to the plating bath. Where the article is to receive a deposit of gold or silver, its surface is usually softened by slightly amalgamating it with mercury to insure perfect adhesion of the deposited metal. The amalgamating is performed by dipping the article, after the cyanide scouring operation, for a few seconds in a solution of mercuric nitrate, 1-7 oz.; sulphuric acid, 1-5 oz.; water, 1 gal. Stir until the solution becomes clear before using. Rinse the work quickly on coming from the mercury dip, and transfer to the plating solution.

The acid, cyanide and mercury dips may be kept in glass or stoneware jars (avoid jars with lead glazing), provided with covers to prevent evaporation.

A "dead luster" is imparted to articles of copper or copper alloy by dipping them for a few minutes in a bath composed of nitric acid (36°), 20 lb.; sulphuric acid (66°), 10 lb.; salt, 1-10 lb.; zinc sulphate, 1-10 lb. Mix the acids gradually, add the zinc salt, then the salt, a little at a time (out of doors to avoid the acid vapors), stir well together, and let it get cold before using. Rinse thoroughly, and pass through the cyanide before putting in the plating bath.

Iron, Cast.—Cast iron is freed from grease, etc., by dipping in a hot alkali solution used for a similar purpose with copper, and after rinsing thoroughly is pickled in water containing about 1% of sulphuric acid for several hours, then rinsed in water and scoured with fine, sharp sand or pumice and a fiber brush. It is then rinsed, and returned to the acid pickle for a short time, rinsed again, and put into the plating bath directly. If more than 1% of acid is used in the pickle the time of immersion must be shortened, otherwise the iron will be deeply corroded, and the carbon which the metal contains, and which is not affected by the acid, will not yield without a great deal of labor to the sand and brush. Cast iron does not gild or silver well by direct deposit. Copper or bronze deposits are better, though not perfect; but if the iron is tinned, the coat is adherent, and will readily receive the other metals.

Iron, Wrought.—The cleansing of wrought iron, if much oxidized, is effected in the same manner as cast iron, but it will bear a stronger pickle and a longer exposure. Whitened, filed or polished iron may be treated like steel.

Steel.—Dip in the caustic lye used for copper, etc., rinse thoroughly, scour with moistened pumice powder, rinse, and pass through the following dip: Water, 1 gal.; hydrochloric acid, 4 lb. Rinse quickly (but thoroughly) and plunge in the bath.

Clean wrought iron and steel gild well without an intermediary coating in hot electrogilding baths. It is difficult to obtain an adherent coating of silver on these metals without interposing an intermediate coating of copper or brass, which renders the further operation of silverplating easy.

Zinc, Tin and Lead.—Zinc is cleansed by dipping for a few moments only (as the alkali quickly attacks the metal) in the hot potash lye, rinsing and dipping into water containing about 10% of sulphuric acid for a few minutes. Rinse in plenty of hot water, and, if necessary, scour with pumice stone powder and a stiff brush, moistened with a weak cyanide solution, or scratch brush. This last operation is especially useful when parts have been united with tin solder.

Tin, lead and the alloys of these metals are more difficult to cleanse perfectly than zinc or iron. Scour rapidly with the hot potash and brush, rinse quickly and brush, or dress with a piece of soft clean wood. It is very difficult to obtain a satisfactory deposit of gold or silver directly upon these metals or their alloys. The results are much better if a coating of pure copper is interposed.

Dipping Acid.

This name is given to a mixture which is frequently used for imparting a bright surface to brass work. When required for dipping brass work preparatory to nickelplating it is commonly composed of sulphuric acid, 4 lb.; nitric acid, 2 lb.; water, 2 qt. In making the above mixture the nitric acid is first added to the water, and the sulphuric acid (ordinary oil of vitriol) is then to be gradually poured in, and the mixture stirred with a glass rod. When cold it is ready for use. The mixture should be kept in a stoneware vessel, which should be covered with a sheet of stout glass. The dipping should always be conducted either in an outer yard or near a fireplace, so that the fumes may escape, as they are exceedingly irritating to the lungs when inhaled. The instant the articles are removed from the dipping bath, they should be plunged in a vessel of water.

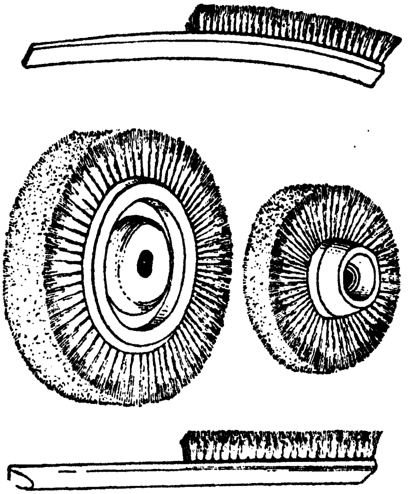
Pickling Bath.

Pickling Bath.—Cast iron before nickeled requires to be placed in a cold acid solution or "pickle" to dissolve or loosen the oxide from its surface. The pickle may be prepared in a wooden tub or tank from either of the following formulae: Sulphuric acid (oil of vitriol), ½ lb.; water, 1 gal. Cast-iron work immersed in this bath for twenty minutes to half hour will generally have its coating of oxide sufficiently loosened to be easily removed by means of a stiff brush, sand and water. When it is desired that the articles should come out of the bath bright instead of the dull black color which they present when pickled in the plain sulphuric acid bath the following formula may be adopted: Sulphuric acid, 1 lb.; water, 1 gal. Dissolve in the above 2 oz. of zinc, which may conveniently be applied in its granulated form. When dissolved add ½ lb. of nitric acid and mix well.

The greatest care should be used in cleansing or pickling before nickeling. The fine iron work which is made at Wernigerode and other places in the Hartz Mountains, is believed to be cleansed in this manner. Work of this class is inexpensive and is very artistic.

Scratch-Brushing.

The scratch brush is often resorted to to remove the dead luster on or to impart a smooth surface to an object. They are usually made of brass or steel wire, and of a variety of shapes to suit the object. Some of the forms are shown in the annexed cut.



Scratch Brushes

The wheel brushes are used on the lathe, the objects being manipulated in contact with the rapidly revolving brush. The brush is usually kept moistened by a small stream of water while in use.

PLATING BY NAMES OF METAL DEPOSITED

Aluminum.

1.—Aluminum may be deposited on copper from a dilute solution of the double chloride of aluminum and ammonia.

2.—Aluminum is one of the most difficult and uncertain of metals to deposit electrolytically. The following recipe is given by Herman Reinbold, who states that it furnishes excellent results: Fifty parts by weight of alum are dissolved in 300 of water and to this is added 10 parts of aluminum chloride. The solution is heated to 200° F., and when cold 39 parts of cyanide of potassium are added. A feeble current should be used.

3.—In *The Jewellers' Journal* the following recipe for electroplating with aluminum is given by Herman Reinbold:

Fifty parts of alum, $AIK\ (SO_4)_2 + 12\ H_2O$, are dissolved in 300 parts of water, and to this 10 parts of chloride of alumina (Al_2Ol_6) are added, heated to 200° and cooled, whereupon 39 parts of cyanide of potassium are added. The object to be plated has to be cleansed, and to be absolutely free from grease in any form, whereupon it is suspended in the bath over the electro-positive electrode, the plate of metallic aluminum to be suspended on the negative pole. The electric current ought to be weak. The plating when polished will be found to be equal to the best silver plating, having the advantage of not being oxidized or getting black when brought into contact with sulphurous vapors, which make it especially valuable for plating spoons and tableware.

4.—The essential features of a new system of electroplating with aluminum are as follows: A solution of ammonia alum in warm water is prepared, containing 20 per cent. of alum. To this is added a solution containing about the same quantity of pearlash and a little ammonium carbonate. The mixture results in effervescence, and in the deposition of a precipitate. The latter is filtered off and well washed with water.

A second solution of ammonia alum, containing 16 per cent. of alum and 8 per cent. of pure potassium cyanide, is now prepared warm and poured over the precipitate previously obtained, the mixture being then boiled for 30 minutes in a closed iron vessel, jacketed to insure uniformity of heating.

The proportions suitable in the above solutions are as follows; First alum solution.—Ammonia alum, 2 kgm.; warm water, 10 kgm. Pearlash solution.—Pearlash, 2 kgm.; warm water, 10 kgm.; ammonium carbonate, 8 to 10 grams. Second alum solution.—Ammonia alum, 4 kgm.; warm water, 25 kgm.; potassium cyanide, 2 kgm.

At this stage about 20 kgm. of water are added and about 2 kgm. more of potassium cyanide, and the whole is kept on the boil for about a quarter of an hour. The liquid is then filtered from the precipitate, and is now ready for use in the electrolytic bath.

The anodes are perforated or slotted plates of aluminum, arranged so that they can be conveniently raised or lowered. The cathodes receive the deposit.

The anodes and the cathodes are connected respectively to the terminals of a battery or of a dynamo machine, and the current is thus transmitted through the bath, which is kept throughout the operation at a temperature of about 80° to 150° F.

By attaching to the aluminum anode pieces of other metals, *e.g.*, gold and silver, nickel, copper, etc., the tint of the deposited metal can be somewhat varied. When the deposit presents a gray tint, it is brightened by dipping the plated article in a solution of caustic soda, which has also the effect of impeding oxidation.

Antimony, Deposition of.

Antimony may be deposited by simple immersion and by means of an electric current; in the latter case the metal may not only be obtained in a state of loose black powder, but also in two distinctly different coherent reguline conditions, viz., as a very brittle metal of a gray slate color and hard crystalline structure; and also in a highly lustrous steel-black deposit of amorphous structure.

The solution used for obtaining the pure gray metal is composed of—350 grams distilled water; 30 grams tartar emetic; 30 grams tartar acid; 45 grams pure hydrochloric acid.

It is not a good conductor and should be used with a current of about 1 volt, so as to deposit about 1 millimeter per week.

For obtaining a bright shining deposit the following solution can be used: 500 grams sulphate of antimony; 1 kilo potassic carbonate; 8 liters water.

Bismuth.

Bismuth may be deposited from a slightly acid solution of the double chloride of bismuth and ammonia.

Brass.

1.—*De Salzede's Process.*—12 parts cyanide of potassium; 610 parts carbonate of potassium; 48 parts sulphate of zinc; 25 parts chloride of copper; 305 parts nitrate of ammonia; 5,000 parts of water. The cyanide is to be dissolved in 120 parts of the water, and the carbonate of potash, sulphate of zinc and chloride of copper are to be dissolved in the remainder of the water, the temperature of which is to be raised to about 150° F. When the salts are dissolved, the nitrate of ammonia is to be added, and the mixture well stirred until the latter is all dissolved. The solution should be allowed to stand for several days before using, and the clear liquor separated from any sediment that may have deposited at the bottom of the vessel.

2.—Cyanide of potassium, 50 parts; carbonate of potassium, 500 parts; sulphate of zinc, 35 parts; chloride of copper, 15 parts; water, 5,000 parts. This solution is to be made up in the same way as No. 1.

3.—Bronzing Solution.—This solution is the same as No. 1, except that 25 parts chloride of tin are substituted for the sulphate of zinc.

4.—Bronzing Solution.—This is the same as No. 2, with the exception that 12 parts chloride of tin are substituted for the sulphate of zinc. This solution is worked warm, that is, at about 97° F.

Electro-deposition of Brass. — Brass has been deposited from a great variety of brassing solutions, as will be seen by reference to the annexed table. Among the first attempts to deposit brass, may be mentioned that of M. De Ruolz in 1841, who employed a mixed solution of the double cyanides of copper, zinc and potassium Cyanide of potassium forms an important ingredient in the majority of brassing solutions, but ammonia in some form is also necessary to keep the solutions in working order.

The following general conditions are to be observed in making up the solutions according to the proportions given in the following table. Fluid ounces of liquids are intended and ounces avoirdupois for the solids. When potassium carbonate (carbonate of potash) is to be used, the copper and zinc salts are first dissolved in water and then precipitated as carbonates from this solution by adding a portion of the potassium carbonate. Where the sign q. s. is given in the foregoing table, a sufficient quantity of the ammonia or cyanide must be added to produce the desired effect, ammonia being generally employed to dissolve the precipitates, forming a deep blue liquid, and cyanide being used until the blue color has all disappeared. Both are employed as solvents to the anodes, which will not freely dissolve unless one or both are present in the solution. Even when a brassing solution is made up without the use of cyanide and ammonia, it is necessary to add them afterward to keep the solutions in working order, as the ammonia alone does not freely dissolve the copper of the anode, and cyanide alone does not dissolve the zinc oxide formed on the anode.

The following details apply to each numbered solution in the foregoing table:

a.—Dissolve all the salts separately in portions of the water; add the ammonia in equal parts to the solutions of the copper and zinc salt with stirring; mix the copper and zinc solutions together, then add the caustic potash solution and lastly the cyanide solution; stir well at frequent intervals during the next twelve hours, then allow the solution to rest a short time before working it.

b.—Dissolve al the salts separately; pour enough potash solution into the solutions of copper and zinc to precipitate all the metal; add ammonia until the precipitate has been dissolved; decolorize with the cyanide, then add remainder of potash and water.

c.—Dissolve all separately; mix copper, zinc and potash solutions, then add the nitrate of ammonia.

d.—Proceed in a similar manner as for No. 3 solution.

e.—Proceed in a similar manner as for No. 3 solution.

f.—Dissolve all the salts; add the cyanide solution to the others with stirring.

g.—Dissolve all the salts in distilled water, mix together and add 2 oz. of sal ammoniac.

TABLE OF BRASSING SOLUTIONS.

	a	b	c	d	e	f	g	h	k	l	m
Water	1280	5000	3200	5000	5000	800	160	250	1000	160	160
Copper acetate	5	....	....	..	..	160	....	....	....	....	....
Copper carbonte	....	....	....	....	....	....	....	....	....	2	....
Copper chloride	....	10	16	25	15	....	....	....	....	....	....
Copper sulphate	....	..	....	....	....	....	....	1	25	....	4
Copper cyanide	....	....	....	....	....	....	2	....	....	....	....
Zinc acetate	....	....	....	....	....	16	....	....	....	....	....
Zinc carbonate	....	....	....	....	....	....	....	....	....	2	....
Zinc cyanide	....	....	....	....	....	....	1	....	....	....	....
Zinc sulphate	10	20	32	48	35	.	....	8	30	....	5
Potassium acetate	....					160	....	....	....	....	....
Potassium carbonate	....	160	400	610	500	....	....	....	....	....	....
Potassium cyanide	8	24	....	12	50	q.s.	16	18	q.s.	4	q.s.
Potassium caustic	72	....	....	....	....	....	....	....	....	....	....
Ammonia liquid	50	q.s.	....	....	....	....	....	....	....	....	....
Ammoniate carbonate	....	....	....	....	....	....	16	....	....	....	....
Ammonia nitrate	....	....	200	305	....	....	....	....	....	....	....
Soda carbonate	....	....	....	....	....	....	....	....	200	4	45
Soda bisulphite	....	....	....	....	....	....	....	....	50	4	7½
Arsenious acid	....	....	....	....	....	....	....	....	....	1|20	....

h.—Dissolve all the salts separately, then mix together.

k.—Dissolved the copper and zinc salts and mix the solutions; add a solution of 100 parts of the carbonate of soda and stir will together; when the precipitate has subsided, pour off the clear liquor, wash the precipitate, add the remainder of the carbonate of soda together with the bisulphite of soda previously dissolved in water, then add enough cyanide to dissolve the precipitate.

1.—Dissolve the zinc and copper salts in water, then add the other ingredients. Dissolve the arsenious acid in the hot cyanide solution before adding it to the soda; drain off all the liquid, wash the precipitate, add the carbonate and bisulphite of soda, then stir in enough cyanide to make a clear solution.

The Brass Baths.—1.—a.—Where the ordinary cheap commercial cyanide is employed, the following answers very well: Sulphate of copper, 4 oz.; sulphate of zinc, 4 to 5 oz.; water, 1 gal.

Dissolve and precipitate with 30 oz. carbonate of soda; allow to settle, decant the clear liquid, and wash the precipitate several times with fresh water—after as many settlings. Add to the washed precipitates: Carbonate of soda, 15 oz.; bisulphite of soda, 7½ oz; water, 1 gal.

Stir to effect solution of these last two, then stir in ordinary cyanide of potassium until the liquid becomes clear and colorless. Filter if much iron or iron oxide (derived from impure zinc salt and cyanide) remains suspended in the liquid. An additional ½ oz. or so of the cyanide improves the conductivity of the solution.

b.—*Management of the Bath.*—The losses of the bath are to be repaired by the addition of copper and zinc salts (and arsenious acid) dissolved in fresh cyanide and water.

The operator determines the requirements from the rapidity of the deposit, its condition, color, etc.

The difficulty in brass electrotyping, especially with small baths, is in keeping the uniformity of the color of the deposit, as the electric current, having to decompose two salts, each offering a different resistance, must, according to its intensity, vary the color and composition of the deposit. A feeble current principally decomposes the copper salt and results in a red deposit; while too great intensity in the current decomposes the zinc salt too rapidly and the deposit is a white or bluish white alloy. If the deposit has an earthy or ocherous appearance, or if the liquid is blue or greenish, the solution is deficient in cyanide. When in proper working order the liquor is colorless. If the coating becomes dull and unequal, a slight addition of arsenious acid will usually improve it.

If the deposit is too red, use more battery power or add more zinc salt; if too white, decrease the current or add more copper salt. The specific gravity of the bath may vary from 5° to 12° Baume; when it exceeds this latter gravity it should be diluted with fresh water to decrease the electric resistance.

If the brass deposit is irregular, remove the articles from the bath, rinse, scratch-brush, and put again into the bath, until the color and thickness of the deposit are satisfactory. Scratch-brush again, and, if necessary, rinse in hot water, dry in warm white wood sawdust, and put in the stove room. The last three operations are indispensable for hollow pieces.

In the disposition of the brass plating bath it is always necessary to have all the articles suspended at about equal distances from the anodes.

The bath may be subdivided by several anodes, forming partitions, so that each loaded rod is between two anodes.

The anodes should always be removed when the bath is not in use.

In order that the brass electroplating of zinc or copper may be lasting the deposit must not be too thin, and must be scratch-brushed, washed in lime water, and dried in the stove room.

Generally ten to twenty-five minutes' exposure in the bath suffices in ordinary practice to throw on a good coating. Cast and wrought iron, lead and its alloys require a bath richer in the metals than when brassplating zinc or its alloys. The battery power should also be greater. For lead the bath works better warm (at about 90° F.). When once placed in the brass bath articles should not be moved about, as there is a tendency under such circumstances to the formation of a red deposit.

In brassplating wire the hot bath is usually employed. As before mentioned, the vessel containing the bath usually consists in an oblong open iron boiler, lined with sheet brass anodes, and heated by fire, steam or hot water. A stout copper or brass rod in the direction of the length of the boiler rests upon the edges, from contact with which it is insulated by pieces of rubber tubing. The rod is connected with the zinc pole of the battery. The binding wires are removed from the coil, the wires loosened and the ends bent together into a loop. The wire is then dipped into a pickle of dilute sulphuric acid, and hung upon a stout round wooden peg fastened in the wall, so that the coil may be made to rotate easily. After a scrubbing with wet sharp sand and a hard brush the coil is given a primary coating of copper. It is then suspended to the horizontal rod, where only a part of the coil at a time dips into the solution and receives the deposit. The coil is then turned now and then one-half or one-fourth its circumference. By dipping the coil entirely into the liquid the operation is not so successful.

The wires are washed, dried in sawdust, and then in the stove room, and lastly passed through a draw plate to give them the fine polish of true brass wires.

The temperature at which the hot bath is commonly used varies between 130° and 140° F.

2.—Sulphate of copper, 4 oz.; sulphate of zinc, 4 to 5 oz.; water, 1 gal. Dissolve and precipitate with 30 oz. of carbonate of soda; allow to settle, pour off the clear liquid and wash the precipitate several times in fresh water. Add to the washed precipitate carbonate of soda, 15 oz.; bisulphite of soda, 7½ oz.; water, 1 gal. Dissolve the above salts in water, assisting the solution by constant stirring; then stir in ordinary cyanide of potassium until the liquid becomes clear and colorless. Filter the solution, and to improve the conductivity, an additional ½ oz. of cyanide may be given.

3.—Morris & Johnson's Process.—A solution is made by dissolving in 1 gal. of water cyanide of potassium, 1 lb.; carbonate of ammonia, 1 lb.; cyanide of copper, 2 oz.; cyanide of zinc, 1 oz. The solution is to be worked at a temperature of 150° F., with a large brass anode and a strong current.

4.—Wood's process consists in making a solution as follows: Cyanide of potassium (troy weight), 1 lb.; cyanide of copper, 2 oz.; cyanide of zinc, 1 oz.; distilled water, 1 gal. When the ingredients are dissolve add 2 oz. sal ammoniac. For coating smooth articles, it is recommended to raise the temperature of the solution to 160° F., using a strong current.

5.—Russell & Woolrich's Process.—A solution is made of the following: Acetate of copper, 10 lb.; acetate of zinc, 1 lb.; acetate of potassium, 10 lb.; water, 5 gal. The salts are to be dissolved in the water, and as much of a solution of cyanide added as will first precipitate the metals and afterward redissolve the precipitate. An excess of cyanide is then to be added and the solution set aside to settle as before. A brass anode or one of zinc and another of copper may be used.

6.—Cold Brass Bath for all Metals.—Carbonate of copper (recently prepared), 2 oz.; carbonate of zinc, 2 oz.; carbonate of soda, 4 oz.; bisulphite of soda, 4 oz.; cyanide of potassium (pure), 4 oz.; arsenious acid, 1-20 oz.; water, 1 gal.

Filter, if necessary.

This arsenious acid is added to brighten the deposit—an excess is apt to give the metal a grayish white color.

Bronze Baths.

1.—Potassic cyanide, 50 parts; potassic carbonate, 500 parts; tin chloride, 12 parts; cupric chloride, 15 parts; water, 5,000 parts. This bath is used at a temperature not exceeding 36° C.

2.—*Bronzing Electro-brassed Work, Green Bronze.*—Mix into a paste with water the following substances: Chromate of lead (chrome yellow), 2 oz.; Prussian blue, 2 oz.; plumbago, ½ lb.; sienna powder, ¼ lb.; lac carmine, ¼ lb. When applying the above composition a small quantity of sulphide of ammonia or chloride of platinum solution may be added.

3.—*Solutions for Depositing Brass or Bronze; Dr. Heeren's Process.*—A brassing solution may be prepared by employing a large excess of zinc to a very small proportion of copper as follows: Sulphate of copper, 1 part; sulphate of zinc, 8 parts; cyanide of potassium, 18 parts. The ingredients are to be dissolved in separate portions of warm water. The copper and zinc solutions are to be mixed and the cyanide solution then added, when 250 parts of distilled water are to be added and the mixture well stirred. The bath is to be used at the boiling temperature with two Bunsen cells. By this process, it is said that very rapid deposits of brass have been obtained upon articles of copper, zinc, Britannia metal, etc.

4.—*French Method of Bronzing Electro-brassed Zinc Work; Steel Bronze.*—This is obtained by moistening the articles with a dilute solution of chloride of platinum and slightly heating them. Since this bronze is liable to scale off with friction, it should not be applied in successive doses, but the solution used should be of such a strength that the desired effect may be obtained if possible by a single application. Copper bronze, that is electro-brass with an excess of copper, may be darkened by dipping it into a warm and weak solution of chloride of antimony (butter of antimony) in hydrochloric acid. Sometimes the color will be violet instead of black.

5.—*French Method of Bronzing Electro-brassed Zinc Work*; *Green or Antique Bronze.*—Dissolve in 100 parts of acetic acid or in 200 parts of good vinegar, 30 parts of carbonate of ammonia or sal ammoniac, and 10 parts each of common salt, cream of tartar and acetate of copper and add a little water. Mix well and smear the object with it, allow it to dry at the ordinary temperature, from twenty-four to forty-eight hours. At the end of that time the article will be found to be entirely covered with verdigris, which presents various tints. It is then to be brushed, but more especially the prominent parts, with a waxed brush, that is a brush passed over a lump of yellow beeswax. The relief parts may then be "set off" with hematite, chrome yellow, or other suitable colors. Light touches with ammonia impart a blue shade to the green parts; carbonate of ammonia deepens the color.

Cadmium.

Cadmium has been electro-deposited from a solution of the double cyanide of cadmium and potassium.

Cobalt, To Electroplate Metals with.

1.—The formulae for nickelplating may be used for cobalt, by substituting cobalt salts for nickel, where these are mentioned.

2.—Cobalt may be electro-deposited from an alkaline solution of the double sulphate of cobalt and ammonia.

Copper.

1.—Where it is intended to simply coat or plate another metal or alloy, the electro deposit of copper is usually obtained by the decomposition of a double salt, such as the cyanide of copper and potassium. This process is adapted to most metals, and affords a fine uniform deposit. The following is a good bath of this description: Water (soft), 1 gal.; acetate of copper (cryst.), 3½ oz.; carbonate of soda (cryst.), 3½ oz.; bisulphate of soda, 3 oz.; cyanide of potassium (pure), 7½ oz.

Moisten the copper salt with water to form a paste (otherwise it is apt to float on the liquid); stir in next the carbonate of soda with a little more water, then the bisulphite, and finally the cyanide with the rest of the water. When solution is complete the liquid should be colorless. If not, add cyanide until it is.

The bath may be employed hot or cold, and requires a moderately strong circuit of electricity. A copper plate forms the anode, and it should expose surface enough to supply the loss of copper—at least a surface equal to that of the work. It must be removed when the bath is not in use.

If the liquid becomes colored, more cyanide must be added.

Large pieces are generally kept hanging motionless in the bath while the plating is in progress; small articles are moved about as much as possible, especially if the bath is warm.

The formula for the bath given above requires pure cyanide of potassium, and where the commercial article, which is often very impure, is used instead, considerable allowance must be made.

2.—*Alkaline Copper Solution.* — The best alkaline copper solution is that introduced by Mr. A. Watt, and subsequently modified by Mr. J. T. Sprague. Dissolve 8 oz. of copper sulphate in 1 qt. hot rain water and set aside to cool. When cool, add liquid ammonia, while stirring with a stick or glass rod. At first a green precipitate will fall, and then this will dissolve on adding more ammonia, until the whole solution assumes a lovely blue tint. Dilute this with an equal bulk of cold rain water, and add to it enough solution of potassium cyanide, while stirring, to destory the fine blue color of the ammonia sulphate and give the color of old ale to the solution. Set this aside for a few hours, then pass it through a calico filter and make it up to a gallon of solution with rain water. This solution may be worked cold, but the rate of deposition is increased and the deposited copper of improved quality when the solution is heated to a temperature of from 110° to 130° F.

3.—*Aluminum.*—a.—Copper cyanide, 6 parts; potassium cyanide, 9 parts; sodium phosphate, 9 parts; distilled water, 100 parts.

b.—According to a Continental contemporary, it is possible to obtain adhesive coats of copper on aluminum by the following method: First clean the aluminum in a warm solution of alkaline carbonate, thus making its surface rough and porous; it is next washed thoroughly in running water, and dipped into a hot solution of hydrochloric acid of about 5 per cent. strength, again washed in clean water, and then placed in a somewhat concentrated acid solution of copper sulphate, until a uniform metallic deposit is formed; it is then again thoroughly washed and returned to the copper sulphate bath, when an electric current is passed until a coating of copper of the required thickness is obtained.

4.—*Electrotyping Non-conducting Materials, New Process for.*—For electrotyping on non-conducting materials, such as china and porcelain, a new and ingenious process has been lately introduced in France. Sulphur is dissolved in oil of spike lavender to a syrupy consistency; then chloride of gold or chloride of platinum is dissolved in ether, and the two solutions mixed under a gentle heat. The compound is next evaporated until of the thickness of ordinary paint, in which condition it is applied with a brush to such portions of the china, glass, or other fabric as it is desired to cover, according to the design or pattern, with the electrometallic deposit. The objects are baked in the usual way before they are immersed in the bath.

5.—*Electro-coppering Flowers, Insects, etc.*—To render non-metallic substances conductive (Parkes).

a.—A mixture is made from the following ingredients: Wax or tallow, 1 oz.; india-rubber, 1 dram; asphalt, 1 oz.; spirit of turpentine, 1½ fl.oz. The india-rubber and asphalt are to be dissolved in the turpentine, the wax is then to be melted, and the former added to it and incorporated by stirring. To this is added 1 oz. of a solution of phosphorus in bisulphide of carbon in the proportion of 1 part of the former to 15 parts of the latter. The articles being attached to a wire are dipped in this mixture; they are next dipped in a weak solution of nitrate of silver, and when the black appearance of the silver is fully developed the article is washed in water; it is afterward dipped in a weak solution of chloride of gold and again washed. Being now coated with a film of gold, it is ready for immersion in the copper bath.

b.—Wax and deer's fat, of each ¼ lb. Melt together and add phosphorus, 10 grams, dissolved in bisulphide of carbon, 150 grams. The wax mixture must be allowed to become nearly cool, when the phosphorus solution is to be added very carefully through a tube dipping under the surface of the mixture. Stir thoroughly. Molds prepared from this composition are rendered conductive by being first dipped in a solution of nitrate of silver, then rinsed, and afterward dipped in a weak solution of chloride of gold, and again washed, when they are ready for the coppering solution.

6.—*Iron and Steel.*—The following formulae required a cyanide containing 70 to 75% (a good average) of pure potassium cyanide.

a.—Cold Bath.—Acetate of copper, 3 oz.; carbonate of soda, 6 1-5 oz.; bisulphite of soda, 3 1-5 oz.; cyanide of potassium, 3¼ oz.; water, 1 gal.; aqua ammonia, 2 1-5 fl.oz. Prepare as before.

b.—Warm Bath.—Acetate of copper, 3 1-5 oz.; carbonate of soda, 3 1-5 oz.; bisulphite of soda, 1 1-5 oz.; cyanide of potassium, 4½ oz.; water, 1 gal.; aqua ammonia, 1 4-5 fl.oz.

7.—*Zinc.*—a.—For small articles of zinc, which are coppered in a perforated ladle and in nearly boiling baths: Acetate of copper, 16 oz.; bisulphite of soda, 3½ oz.; cyanide of potassium, 25 oz.; aqua ammonia, 5½ oz.; water, 4 to 5½ gal.

In the preparation of these baths the salts are all dissolved together, except the copper acetate and ammonia, which are added after dissolving together in a small quantity of the water.

The deep blue color of the ammonio-copper solution should entirely disappear on mixing it with the other solution; otherwise it becomes necessary to add more cyanide.

The cold bath is put into well joined tanks of oak or fir wood, coated inside with gutta percha or asphaltum (genuine). The vertical sides are also covered with sheets of copper, all connected with the last carbon or copper of the battery by a stout copper wire with well cleaned ends, the other pole of the battery being in similar connection with a stout brass rod extending the length of the tank (without any point of contact with the anodes), and from which the work is suspended by hooks or trusses in the bath.

With a thin deposit the coating is sufficiently bright to be considered finished after being rinsed and dried. But if the operation is more protracted the deposit has a dead luster on account of its thickness, and if a bright luster is desired it is necessary to use the scratch-brush.

The hot baths are usually put into stoneware vessels heated by a water or steam bath, or into an enameled cast-iron kettle placed directly over a fire. The vessels are lined inside with copper, the edges of the vessel being varnished, or support a wooden ring upon which rests a brass circle connected with the zinc pole of the battery. The objects to be electroplated are suspended from this ring.

The hot process is more rapid than the cold, and is especially adapted to those articles which are difficult to cleanse. The articles are kept in continual agitation, which permits of the employment of a strong current of electricity. Small articles of zinc are placed in a perforated stoneware or enameled ladle, at the bottom of which is attached a copper wire which is wound up around the handle and connected with the zinc pole of the battery. It is sufficient that one of the small articles touches the wire for all to be affected by the current, as they are in contact with each other. The ladle must be continually agitated, so as to change the points of contact of the objects. What has been said in regard to electro brassplating, will apply here.

b.—This bath is composed as follows: Crystallized acetate of copper, 200 grams; carbonate of soda, 200 grams; crystallized bisulphide of soda, 200 grams; potassic cyanide, 300 grams; distilled water, 10 liters.

This solution should be energetically boiled before being used.

Gold.

1.—In the practice of electroplating with gold the bath employed is usually heated, as the deposits obtained in such a bath are more homogeneous, tenacious and durable, and of a better color, besides which recommendation a greater quantity of the metal may be deposited satisfactorily from it in a given time than from a cold bath.

Owing to the cost of the metal to be deposited very large surfaces are rarely required to be electroplated, and as these baths become worn out and must be replaced by fresh solutions after a short time, they are usually, as a mater of economy and convenience, used in as small a vessel as the circumstances will admit of. These vessels may be of glass, porcelain, or porcelain-enameled iron. The latter serve the purpose admirably (if the enamel is good). They should be heated over the water bath or by means of steam.

The same bath does not answer very well for all metals—either the bath must be modified to suit the metal or the latter must be previously coated with another metal to suit the conditions. Gold deposits are obtained with the greatest facility upon silver or copper, their rich alloys, or other metals coated with them. With these a hot bath (at about 170° F.) and a moderately strong current give good results. With alloys, such as German silver, the best results are obtained with a weak bath, barely warm. Steel and iron, when not coated with copper, require an intense current and a very hot bath. Lead, zinc, tin, antimony and bismuth alloys of, or containing much of these, are preferably coated with copper before electrogilding.

2.—Operations Connected with Electrodeposition.—Solution for protecting plated work, which is to be gilded in a hot cyanide bath, frm receiving the gold deposit upon parts of the ornamental work: Clear rosin, 10 parts; yellow beeswax, 6 parts; best red sealing wax, 4 parts; jeweler's rouge, 3 parts. The three first named substances are to be thoroughly melted, with gentle stirring, and the ruge, which is the peroxide of iron, gradually added and incorporated with stirring. The article to which the stopping off varnish has been applied should never be placed either in a hot or cold bath until it has become thoroughly dry and hard.

Aluminum.—Gold chloride, 2 parts; potassium cyanide, 2 parts; sodium phosphate, 2 parts; water, distilled, 100 parts.

Amateurs' Gilding Solution.—The best and cheapest solution for amateur electrogilding, and also for operators in a small way of business, is the double cyanide of gold and potassium solution made by the battery process. This contains some oxide of potash, but if made up of pure gold and pure 98% cyanide of potassium, it will yield good results at once, and continue to give them for years if kept in proper working condition. This solution is made up in the following manner: Procure 5 dwts. pure gold ribbon, leaf, or wire (and divide it into 2 parts), 3 dwts. pure white 98% cyanide of potassium and 1 qt. of distilled water. Dissolve the cyanide of potassium in the distilled water made hot in a good enameled saucepan, and keep it at nearly scalding heat while making and working the gilding solution. Make up a battery of two Bunsen cells or three Daniel cells in series. Hang one strip of gold from the wire leading to the negative element of the battery, and the other strip to the wire leading to the positive element of the battery. Get a small, clean, white porous battery cell, nearly fill it with cyanide of potassium solution, place it in the saucepan and suspend in the porus cell the strip of gold connected to the zinc element of the battery. Immerse the other strip of gold in the outer cyanide solution, and pass current (from the battery) from one to the other for some two or three hours. During that time some of the gold will have dissolved off the anode strip and entered into combination with the cyanide of potassium solution to form the double cyanide of gold and potassium gilding bath, but this will not have penetrated into the porous cell, nor will the strip of gold therein have suffered any loss. If at the end of this time a piece of German silver, suspended from the cathode wire in the outer solution, receives a fair coat of gold in a few moments, the bath is ready for gilding work. The contents of the porous cell may be poured into the outer solution, both strips of gold used as the anode, and the work may proceed with current from one or more cells, as may be required. At first there may be too much free cyanide, and the deposit may in consequence be too dark, but this fault will soon be corrected if the anode plates are wholly immersed while gilding. If the contrary condition exists, and the anode plates are dirty, or do not dissolve freely, add a very little more cyanide to the solution. This will be found to be the cheapest solution, because there is no loss of material in making it up. If the whole of the gold strip dissolves in the cyanide solution, the bath will not be too rich in gold, as a very useful strength is 2 dwts. of gold in the quart of solution. A larger quantity may be made in the same manner in the same proportions.

Brass.—Jewelry.—1.—For Producing a Matted Surface on Brass Articles of Jewelry, as Brooches, Lockets, etc.—First dip them for an instant in a mixture composed of equal parts of sulphuric and nitric acids, to which a small quantity of common salt is added; plunge immediately in cold water. Rinse in one or two other waters, then immerse in the gilding bath, in which, after a moment's immersion, they acquire the desired color of gold. After rinsing in hot water they are finally dried in hot boxwood sawdust.

2.—a.—French Gilding for Cheap Jewelry.—The bath for gilding recommended by Roseleur is composed of pyrophosphate of soda or potassa, 800 grams; hydrocyanic acid (prussic acid), 8 grams; chloride of gold crystallized, 20 grams; distilled water, 10 liters. The pyrophosphate of soda is generally employed and this may be prepared by melting at a white heat ordinary crystallized phosphate of soda in a crucible. The quantity of gold given in the above formula represents the grams of the pure metal dissolved by aqua regia. In making the bath 9 liters of water are put into a porcelain vessel and the pyrophosphate added, with stirring a little at a time, moderate heat being applied until all the salt is dissolved. The solution is then filtered and allowed to cool. The chloride of gold is allowed to crystallize, the crystals dissolved in a little distilled water, and the solution filtered. Add the chloride solution to the cold solution of pyrophosphate of soda, then add the hydrocyanic acid and heat to near boiling point.

This bath will produce fine gilding upon well cleaned articles, which must also have been passed through a very diluted solution of nitrate of mercury, without which the deposit of gold is red and irregular. The articles must be constantly agitated in the bath, and supported by a hook, or placed in a stoneware ladle perforated with holes.

b.—The following solution, to be used at a temperature of from 120° to 180° F., is recommended by M. E. Rod in *Le Monde de La Science:* Crystallized phosphate of soda, 60; bisulphate of soda, 10; cyanide of potassium, 1; chloride of gold, 2½; distilled or rain water, 1,000 parts by weight. To prepare this bath properly the water should be divided into three portions, viz., one of 700 parts and two of 150 parts. The sodic phosphate is dissolved in the first portion, the chloride of gold in the second, and the bisulphate of soda and cyanide of potassium in the third. The first two portions are gradually mixed together, and the third is afterward added. With this solution M. Rod uses a platinum anode (a wire or strip), adding fresh portions of the gold salt as the solution becomes exhausted.

c.—Cold Electrogilding Solution.—The cold gilding bath is sometimes used for very large objects, as clocks, chandeliers, etc., to avoid the necessity of heating large volumes of liquid—Ferrocyanide of potassium (yellow prussiate of potash) 20 parts, pure carbonate of potash 30 parts, sal ammoniac 3 parts, gold 15 parts, water 1,000 parts. All of the salts except the chloride of gold are to be added to the water, and the mixture boiled and afterward filtered. The chloride of gold is next to be dissolved, in a little distilled water and added to the filtered liquor. The deposit of gold from cold solutions varies greatly as to color. When the bath is in its best working condition, and a brisk current of electricity employed, the gold should be a pure yellow color.

d.—M. De Briant's Solution.—Dissolve 34 grams of gold in aqua regia, and evaporate the solution until it becomes neutral chloride of gold; then dissolve the chloride in kilograms of warm water and add to it 200 grams of magnesia; the gold is precipitated. Filter and wash with pure water; digest the precipitate in 40 parts of water, mixed with 3 parts of nitric acid, to remove magnesia, then wash the remaining (resulting) oxide of gold with water, until the wash water exhibits no acid reaction with test paper (litmus paper). Next dissolve 400 grams (ferrocyanide of potassium (yellow prussiate of potash) and 100 grams of caustic potash in 4 liters of water, add the oxide of gold, and boil the solution about twenty minutes. When the gold is dissolved, there remains a small amount of iron, precipitated, which may be removed by filteration, and the liquid of a fine gold color is ready for use; it may be employed either hot or cold.

e.—Fizeau's Solution.—(1) 1 part of dry chloride of gold is dissolved in 160 parts distilled water; to this is added gradually a solution of a carbonated alkali, in distilled water, until the liquid becomes cloudy. This solution may be used immediately.

(2) 1 gram chloride of gold: 4 grams hyposulphite soda, distilled in 1 liter of distilled water.

3.—Wood's Solution.—4 oz. (troy) cyanide of potassium; 1 oz. cyanide gold, dissolved in 1 gal. distilled water. The solution is used at a temperature of about 90° F., with a curent of at least two cells.

Cold Electrogilding Bath.—Water, distilled, 1 gal.; potassium cyanide, pure, 3 1-5 oz.; gold chloride, 3 1-10 oz.

Dissolve the cyanide in a part of the water, then gradually add the gold chloride dissolved in the remainder. Boil for half an hour before using. (Use cold.)

The cold bath is kept in a gutta percha lined, wooden, or (if small) porcelain tank arranged as for brassplating. The anodes are thin plates of laminated gold, wholly suspended in the liquid (while in use) by means of platinum wires, from clean brass rods joined to the copper or carbon pole of the battery, the rods supporting the work being in connection with the zinc. When in proper working order the color of the deposit is yellow. If the deposit becomes black or dark red, add more cyanide (dissolved in water) to the bath, or use a weaker current.

If the cyanide is in excess the plating will proceed very slowly or not at all; or, as sometimes happens, articles already gilded will lose their gold. In such a case add a little more gold chloride or increase the intensity of the current.

Cold electrogilding must be done slowly, and requires a great deal of attention to secure good work. The articles must be frequently examined to detect irregular deposits or dark spots (which must be scratch-brushed and returned). It is also frequently necessary to add to or remove an element from the battery, especially when adding or taking work from the bath. With too much intensity of current the deposit is black or red; if too weak those portions opposite the anode only get covered. In coating German silver it is necessary to use a weak bath and a small exposure of anode. The best results with this alloy are obtained when the bath is slightly warmed.

Hot Baths.—1.—For copper, silver, or alloys rich in these.—Distilled water, 1 gal.; phosphate of soda, cryst., 9½ oz.; bisulphite of soda, 1 3-5 oz.; cyanide of potassium, pure, 1-6 oz.; gold chloride, 160 gr.

Dissolve in a portion of the water, heated, the phosphate of soda. Dissolve in another portion of the water the bisulphite of soda and cyanide of potassium.

Dissolve the gold chloride in the remaining water, stir the solution slowly into the cold phosphate of soda solution, and finally add the solution of cyanide and bisulphite. The bath, now ready for use, should be colorless.

2.—Bronze and Brass.—a.—The following baths work well with bronze and brass, but are not suited for direct gilding on iron or steel: Distilled water, 1 gal.; phosphate of soda, cryst., 6 2-5 oz.; bisulphite of soda, 1 3-5 oz.; bicarbonate of potash, 4-5 oz.; caustic soda, 4-5 oz.; cyanide of potassium, pure, 1-5 oz.; gold chloride, 2-5 oz.

Dissolve all together, except the gold chloride, in the hot water; filter, cool and gradually stir in the gold chloride dissolved in a little water. Heat from 120° to 140° F. for use. It requires an intense current.

b.—Distilled water, 1 gal.; ferrocyanide of potassium, 5¼ oz.; carbonate of potash, pure, 1¾ oz.; sal ammoniac, 2-3 oz.; gold chloride, 2-3 oz.

Dissolve as in the last, boil for half an hour, replace the evaporated water, and the bath is ready for use.

c.—Distilled water, 1 gal.; cyanide of potassium, 2 4-5 oz.; gold chloride, 1 oz.

Dissolve the gold chloride in the water, then add the cyanide, and stir until solution is complete.

Baths of this kind are commonly used, and with little regard to temperature. They are simple in preparation, but are, unfortunately, not very uniform in their working, ungilding one part while another is gilding, and producing a variety of colors, especially when freshly prepared. They improve by use, however.

3.—Iron and Steel—Uncoated, Bath for.—Distilled water, 1 gal.; phosphate of soda, cryst., 7 8-10 oz.; bisulphite of soda, 2 oz.; cyanide of potassium, pure, 3-5 drams; gold chloride, 160 grains.

Dissolve as before. Heat to 175° or 180° F. Pass the second metal through the hot potash, then through dilute muriatic acid (acid 1, water 15), brush, and connect at once. Requires a very intense current at first.

4.—Management of the Hot Bath.—The articles should be kept in agitation while in the bath. They should be placed in connection with the battery before or immediately upon entering the bath. A foil or wire of platinum is in many cases preferable to a soluble gold anode when electrogilding by aid of heat. It suffers no alteration in the liquid, and by its manipulation the color of the deposit may be materially altered. When it is removed so as to expose only a small surface in the bath a pale yellowish deposit may be obtained; when the immersion is greater, a clear yellow; with a still greater exposure, a red gold color. The strength of the hot baths may be maintained by successive additions of gold chloride with a proper proportion of the other salts and water; but it is preferable to wear out the bath entirely and prepare a new one, as it soon becomes contaminated with copper or silver if much of these metals have been gilt in it. In a nearly exhausted bath containing dissolved copper the electro deposit will be what is called "red gold"; if it contains an excess of silver a "green gold" deposit will result. The gold and copper or gold and silver are deposited together as an alloy, the color of which depends upon the relative proportion of the metals, battery, strength, etc.

Dead luster gilding is produced by the slow deposition of a considerable quantity of gold, by giving the metallic surface a dead luster before gilding (by means of acids), by first preparing a coating of frosted silver or by depositing the gold upon a heavy copper deposit produced with a weak current in a bath of copper sulphate.

In order to secure a good deposit of gold it is absolutely necessary that the work should be perfectly freed from any trace of oxide, grease, oil, or other impurity. Articles of copper and brass may be cleansed by first immersing them in a strong boiling solution of caustic potash or soda, and, after rinsing, dipping momentarily in nitric acid and immediately rinsing, or scouring with pumice stone moistened with a strong solution of cyanide of potassium in water.

Other metals require a somewhat different treatment, which we will have occasion to refer to in a subsequent article.

Lead, Britannia Metal, etc.—When articles composed of lead, tin, Britannia metal, iron or steel are required to be gilded it is best to give them a preliminary coating of copper in an alkaline bath, or to electro-brass them, after which they may be easily gilded. The softer metals need to be burnished with greater care, owing to their yielding nature under the pressure of the burnishing tools.

Steel, Polished.—For gilding polished steel, a nearly neutral solution of chloride of gold is mixed with sulphuric ether and well shaken. The ether will take up the gold and the ethereal solution float above the denser acid. If the ethereal solution be applied by means of a camel's-hair brush to brightly polished steel or iron, the ether evaporates and the gold, which adheres more or less firmly, becomes reduced to the metallic state on the steel, and may be either polished or burnished. Steel receives a deposit of gold with great rapidity, even with a very weak battery current.

Iron.

Electro-deposition of Iron, Solutions for.—1. Ammonia Sulphate of Iron Solution.—This double salt, which was first proposed by Boettger, for depositing this metal, may be readily prepared by evaporating and crystallizing mixed solutions of equal parts of sulphate of iron and sulphate of ammonia. A solution of the double salt yields a fine white deposit of iron, with a moderate current, and has been very extensively employed in "facing" engraved copper plates. When carefully worked this is one of the best solutions for the deposition of iron upon copper surfaces.

2.—Boettger's Ferrocyanide Solution.—This solution for coating engraved copper plates with iron is formed by dissolving 10 grams of ferrocyanide of potassium (yellow prussiate of potash) and 20 gr. of Rochelle salts in 200 cubic centimeters of distilled water. To this solution is added a solution consisting of 3 grams of persulphate of iron in 50 cubic centimeters of water. A solution of caustic soda is then added drop by drop, with constant stirring, until a perfectly clear, light, yellowish liquid is obtained, which is ready for immediate use.

Boettger's process, as far as we are aware, has never been improved on. It is as follows: Mix 100 parts of ferrous ammonium chloride and dissolve the mixture in 500 parts of distilled water. Render the solution slightly, but distinctly acid by the addition of sulphuric acid drop by drop. The surface to be plated is connected with the negative pole of a battery, an iron plate of equal size being connected with the positive pole and serving as an anode. For small articles two or three Bunsen elements will answer very well. Maintain the solution at from 75° to 80° F. The deposited iron is very pure, white, very hard and steel-like, and accumulates very rapidly. In this manner copper, zinc, type metal, etc., may be given a surface as hard as steel plate and at a minimum cost. Of course the article to be plated should be rendered perfectly clean before it is put into the bath.

3.—*Copper.*—Prof. Boettger recommends the following solution for coating copper plates with iron: 10 parts of ferrocyanide of potassium and 20 parts of tartrate of soda are dissolved in 220 parts of distilled water, adding a solution of 3 parts of sulphate of iron in 50 parts of water. Caustic soda solution is poured into the mixture until the Prussian blue formed is redissolved.

Lead.

May be deposited from its acetate solution or from a solution of oxide of lead, in caustic soda or potash, in the form of beautiful metallo-chromes, on polished surfaces of steel or nickel.

Magnesium.

Has been deposited from a solution of the double chloride of magnesium and ammonia.

Nickel.

Preparation of Nickel Solution.—1. The substance generally employed is the double sulphate of nickel and ammonia, or "nickel salts," a crystalline salt of a beautiful green emerald color. This article should be pure. For 100 gal. of the solution the proportions employed are: Double sulphate of nickel and ammonia, 75 lb.; water, 100 gal. Place the nickel salts in a clean wooden tub or bucket and pour upon them a quantity of hot or boiling water; stir briskly with a wooden stick for a few minutes, after which the green solution may be poured into the tank, and a fresh supply of hot water added to the undissolved crystals, with stirring as before. This operation is to be continued until all the crystals are dissolved, and the solution transferred to the tank. A sufficient quantity of cold water is now to be added to make up 100 gal. in all. It is better to pass the hot solution through a strainer before it enters the tank, to free it from impurities.

2.—Nickelplating.—The Plating Bath.—The nickel salts commonly used are the nickel ammonium sulphate (called double sulphate) and the corresponding chloride. Other salts, such as the nickel potassium cyanide, the acetate and sulphate, have been used, but not so successfully as these.

The double sulphate bath may be prepared by dissolving ¾ lb. of the salt in each gallon of water (soft). The salt costs about 65 cents a pound, and is generally considered the best for this purpose. It should be kept neutral and up to about 6° of hydrometer.

The double chloride bath requires about 4 oz. of the salt per gallon, and works better toward alkalinity.

The bath should be filtered when freshly prepared, and should be kept in a separate room, or at least away from the apartment in which the buffing or polishing is performed, to avoid contamination by dust as much as possible. Exposed to the air, the bath (the water) evaporates, and the water thus lost must be replaced from time to time. To retard this and keep out dust as much as possible, it is well to cover the bath when not in use. Its surface should be skimmed occasionally and it should be frequently mixed together to preserve a uniform degree of strength.

The tank or vessel in which the bath is contained is usually constructed of smooth 2-in. white pine stuff, grooved and well bolted together and coated on the inside with good asphaltum applied in the melted state.

Instead of this form, a clean tub or a half barrel or hogshead, with an extra hoop, may be used, though from the shape of such a vessel there is necessarily much waste space to be filled with useless liquid.

For small baths a neat form of vessel consisting in a square porcelain lined (enameled) iron tank of suitable dimensions is sold by some of the dealers in electroplating materials.

3.—Anodes or Feeding Plates.—Good pure cast nickel anodes are now obtained at a moderate cost ($1.85 per lb.), and are preferable to grain metal anodes. They usually come in sizes ranging from 1¾x4 in., 3-16 in. thick, to 8x12 in., ⅝ in. thick.

They may be suspended around the sides of the tank or across and facing the work (care being taken to avoid bringing them into such close proximity to the work that contact is likely to occur under any circumstances. They may be suspended by clean copper trusses or hooks —which should not be permitted to touch the liquid—from stout copper rods, to which connection with the battery is made.

4.—The Battery.—In nearly all large electroplating establishments some form of dynamo-electric machine is now used instead of the battery. They are cleanly, require little attention and space, and afford a current more easily adapted to the work and at a much smaller cost.

But as their first cost is considerable, and they require power to operate them, the old battery is still in requisition in smaller establishments. The carbon or chromic acid battery is more commonly used, as it admits of more rapid work with a smaller number of cells; but as it supplies a very intense current, it often becomes necessary to introduce resistance coils to reduce it where small work is on hand. Some of the best work we have ever seen has been produced with the current derived from two or three Smee or sulphate of copper cells (in series). The amount of battery power for a given amount of work should be in zinc surface (exposed) about equal (when in proper working order) to the surface of the work exposed in the plating bath, with care to preserve the tension. If one cell has a zinc surface (exposed) of, say, one hundred square inches, and the work, say, five hundred, the one cell will require to be multiplied by five for quantity and (if the original tension was, say, three) by three to preserve the tension. Thus:

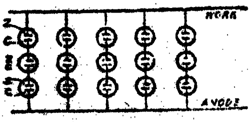


Diagram of Connections

Of course this is equivalent to three large single cells, each exposing five hundred square inches of zinc (equal to a plate about sixteen inches square, exposing both sides). Large batteries of the dipping form, admitting of the immersion of the proper quntity of zinc, are often convenient.

If the current is too strong the deposited metal will present a dull (commonly termed burnt) appearance; if too weak it is apt to be imperfect, granular, or semi-crystalline.

For practical purposes the electricity may be said to proceed from the copper or carbon pole of the battery, and care should be taken that this pole is invariably connected (by stout copper wires or rods) with the anodes or feeding plates in the plating bath, for if misconnected damage is done both to the work and the bath by the corrosion or partial solution of the former in the latter.

5.—Preparing the Work.—Before work can be plated its surface must be freed perfectly from all traces of oil or grease, oxides, lacquer, and other impurties. Oil, grease, etc., are removed by contact with a strong, hot acqueous solution of caustic potash, and, after rinsing off the adhering alkali, from oxide by an acid bath; or, if of brass, copper, or German silver, by scouring with fine pumice stone and strong acqueous solution of cyanide of potassium. Iron is pickled in diluted sulphuric or muriatic acid (acid 1, water 5 to 15), and scoured with fine white silicious sand or pumice stone. Brass or copper is sometimes brightened before entering to the plating bath by dipping it momentarily in nitric acid diluted with about 20 parts of water, and quickly rinsing it in running water. It should be placed in circuit immediately after this.

The hand must not come into contact with any part of the work after removal from the alkali, as the slightest touch may spoil all.

On removal of the plated work from the plating bath it should be quickly rinsed (without handling) in cold water, then transferred to hot water, which will cause it when taken out to dry quickly and perfectly. If the finished work is to present a smooth polishing surface it must present such a surface before entering the plating bath. Nickel is hard and will not readily submit to a burnishing tool.

When the work is placed in circuit in the plating bath (and it should not be permitted to remain many moments in the bath without being placed in circuit) it should be moved about to free it from bubbles.

The process of nickelplating is a simple one, and by a little practice and proper attention to the requirements the bath may be worked month after month, and the metal deposited smoothly and with certainty.

Formulae for Nickelplating Solutions.
1.—Double sulphate of nickel and ammonium, 5 to 8 parts; water, 100 parts.

Dissolve the nickel double salt in above quantity of water with the aid of heat. Cautiously add ammonia, or the sulphate of ammonium, until the solution is neutral to test paper. This solution should be maintained as nearly neutral as possible in use. This is commonly known in the United States as the Adams solution. It is in very general use by nickelplaters throughout the United States, and yields, where properly managed, excellent results.

2.—Double sulphate of nickel and ammonium, 10 parts; boric acid (refined), 2½ to 5 parts; water, 150 to 200 parts.

(Weston's solution.) The superiority of this solution is generally acknowledged. The deposited metal, as previously remarked, is almost silver-white, dense, homogeneous and tenacious, and the solution maintains its excellent working quality very uniformly in long-continued service.

The nickel salt and boric acid may be dissolved separately in boiling water, the solutions mixed, and the volume brought up to that of the formula, or the two components may be dissolved together.

3.—Acetate of nickel, 2¾ parts; acetate of calcium, 2½ parts; water, 100 parts.

To each gallon of this solution add 1 fl. oz. of acetic acid, 1.047 sp. gr.

To prepare this bath, dissolve about the same quantity of the dry carbonate of nickel as that called for in the formula (or three-quarters of that quantity of the hydrated oxide) in acetic acid, adding the acid cautiously, and heating until effervescence has ceased and solution is complete. The acetate of calcium may be made by dissolving the same weight of carbonate of calcium (marble dust) as that called for in the formula (or one-half that quantity of caustic lime), and treating it in the same manner. Add the two solutions together, dilute the volume to the required amount by the addition of water, and then to each gallon of the solution add a fluid ounce of free acetic acid, as prescribed. (Potts' solution.)

4.—Sulphate of nickel and ammonium, 10 parts; sulphate of ammonium, 4 parts; citric acid, 1 part; water, 200 parts.

The solution is made with the aid of heat, and, when cool, small fragments of carbonate of ammonium should be added until the bath is neutral to test paper.

5.—Sulphate of nickel, 6 parts; citrate of nickel, 3 parts; phosphate of nickel, 3 parts; benzoic acid, 1½ parts; water, 200 parts.

6.—Phosphate of nickel, 10 parts; citrate of nickel, 6 parts; pyrophosphate of sodium, 10½ parts; bisulphite of sodium, 1½ parts; citric acid, 3 parts; aqua ammonia, 15 parts; water, 400 parts.

7.—Sulphate of nickel, 6 parts; aqua ammonia, 3 parts; water, 100 parts.

When the nickel is dissolved add aqua ammonia, 20 parts.

This bath is similar to that recommended by Prof. Boettger; it is said to be well suited for the purposes of amateurs, inasmuch as it gives good results with a platinum anode. It is worked at a temperature of 100° F., with a moderate current. It requires renewal from time to time, as it becomes impoverished in nickel, by addition of fresh nickel salt; it must also be kept alkaline by the occasional addition of ammonia.

8.—Sulphate of nickel and ammonium, 10 parts; sulphate of ammonium, 2 parts; water, 250 parts.

Dissolve in boiling water, and allow to cool. These proportions are recommended for coating objects of cast and wrought iron and steel.

9.—Sulphate of nickel and ammonium, 10 parts; sulphate of ammonium, 2 parts; water, 300 parts.

Dissolve as above. Recommended for coating brass, copper, tin, britannia, lead, zinc, etc.

10.—Sulphate of nickel and ammonium, 6 parts; chloride of ammonium (sal ammoniac), 3 parts; water, 100 parts.

A large number of American manufactories use the following recipes for nickeling:

11.—Bath for Brass, Copper, Tin, Britannia, Metal, Lead, Zinc and Tinned Sheet Metal.—13 gal. of water, 4 lb. double sulphate of nickel and ammonium, 14 oz. sulphate of ammonium; dissolve by boiling. Let the liquid cool. Test with red or blue litmus paper. Add a little hydrochlorate of ammonia if any acid is present.

12.—Ordinary Nickel Bath.—4¼ gal. of water, 1¼ lb. of double sulphate of nickel and ammonium, ¾ lb. hydrochlorate of ammonia; dissolve by boiling.

Make the fluid slightly alkaline by adding 1½ lb. of caustic ammonia. The fluid should show 3° to 4° by the hydrometer.

13.—3½ gal. water, 2 lbs. double sulphate of nickel and ammonium, 21 oz. hydrochlorate of ammonium, 14 oz. sulphate of ammonium; dissolve by boiling. Let the liquid cool.

14.—Powell's Process.—This inventor claims that benzoic acid added to any of the nickel salts arrests the tendency to an imperfect deposit, prevents the decomposition of the solution and consequent formation of subsalts. The proportion of benzoic acid to be added to the bath is ⅛ of an oz. to a gallon of the solution. Powell gives the following formulae for nickel baths:

a.—Sulphate of nickel and ammonia, 10 parts; sulphate of ammonia, 4 parts: citric acid, 1 part; water, 200 parts. The solution is prepared with the aid of heat, and, when cool, a small quantity of carbonate of ammonia is added, until the solution is neutral to test paper.

b.—Sulphate of nickel, 6 parts; citrate of nickel, 3 parts; phosphate of nickel, 3 parts; benzoic acid, 1½ parts; water, 200 parts.

15.—A new nickel-plating solution, said to yield beautiful results, is prepared by mixing the liquid obtained by evaporating a solution of ½ oz. nickel in aqua regia to a pasty mass and dissolving it in 1 lb. aqua ammonia, with that obtained by treating the same quantity of nickel with a solution of 2 oz. cyanide of potassium in 1 lb. of water. More cyanide renders the deposit whiter and more ammonia renders it grayer.

16. — *Aluminum.* — Nickel chloride, 7 parts; sodium phosphate, 7 parts; distilled water, 100 parts.

Warm the baths from 60° to 70° C. and maintain them at this temperature throughout.

17.—*Small Articles, such as Umbrella Mounts, etc.*—Double sulphate of nickel and ammonium, 7 kgm.; bicarbonate of soda, 800 grams; water, 100 l. The bicarbonate of soda must be added when the nickel solution is warm, in small quantities at a time, otherwise the effervescence which occurs might cause the solution to overflow. The bath is to be worked up to nearly boiling point. If, after working for some time, the deposit becomes of a darkish color, add a small lump of sulphide of sodium, which will remedy it.

18.—*Renickeling Old Work.*—When goods which have been nickelplated require to be renickeled, it is always better to remove the old coating by means of a stripping solution, as nickel will not adhere to a coating of the same metal. A stripping bath may be composed as follows: Oil of vitriol, 16 lb.; nitric acid, 4 lb.; water, 2 qt. Add the oil of vitriol to the water (not the reverse, which is dangerous) gradually, and when the mixture has cooled down, add the nitric acid, and stir the mixture with a glass rod. When cold it is ready for use. Attach the articles to be stripped to a piece of stout brass or copper wire and place in the stripping liquid; they should be examined after a few moments. The operation of stripping should be conducted in the open air or in a fireplace with good draught. The articles should not be allowed to remain in the liquid one moment after the nickel has been dissolved from the surface, but be immediately removed and plunged into cold water.

19.—Tin, Britannia Metal, etc.—Sulphate of nickel and ammonium, 10 parts; sulphate of ammonium, 2 parts; water, 300 parts. The salts are to be dissolved in boiling water, and when cold the solution is ready for use. For nickeling cast and wrought iron and steel the following bath is recommended: Sulphate of nickel and ammonium, 10 parts; sulphate of ammonium, 1½ parts; water, 250 parts.

Palladium.

1.—Palladium may be deposited from the double cyanide of palladium and potassium, or from the double chloride of palladium and potassium.

2.—Palladium, which is a whiter, lighter and more fusible metal than platinum, has of recent years been much used to plate watch movements, says the *Electrician.* According to M. Pilet, four milligrammes (about one-seventeenth of a grain) of palladium is sufficient to coat the works of an ordinary-sized watch. M. Pilet recommends the following bath: Water, 2 l.; chloride of palladium, 10 grams; phosphate of ammonia, 100 grams; phosphate of soda, 500 grams; benzoic acid, 5 grams. This bath is suitable for all metals except zinc.

Platinum.

1. — *Carbon (Walker).* — The carbon plate is purified by immersion for several days in sulphuric acid diluted with 3 or 4 times its volume of water, then put into a bath of sulphuric acid diluted with 10 times its volume of water, with crystals of chloride of platinum added until it becomes straw-colored.

The carbon is connected to the — pole

of the battery and a platinum or carbon plate connected to the + pole serves for anode. After twenty minutes the carbon is platinized, as may be proved by using it to decompose water. The hydrogen should freely rise from its surface.

2.—*Iron.*—Steep the iron plate in an acid solution of platinum in aqua regia.

Silverplating.

3.—*Silver.*—For use in Smee cells. The silver plate to be coated is plunged in a bath of bichloride of platinum and acidulated water. A current is sent through the bath from a platinum anode, the silver serving as cathode. A rough coating of platinum takes place on the silver.

Simple Instructions for.—1.—For silver plating the bath consists of potassium silver cyanide, prepared by precipitating solution of silver nitrate with potassium cyanide and redissolving the washed precipitate in excess of potassium cyanide solution—potassium cyanide, 12 oz.; water, 1 gal.; silver cyanide, about 1 troy oz. Filter and use in a porcelain or glazed vessel. For the whitening bath dissolve 1 lb. potassium cyanide in 1 gal. of water, add ¼ oz. troy of silver cyanide and filter the solution. The baths are provided with silver feeding plates for anodes proportioned in size to the surface of the work to be plated. These are connected with the positive pole of battery. The cleaned articles are connected by a copper wire with the zinc pole of the battery, dipped for a minute or two in the whitening bath, and when uniformly coated with a white film of silver, transferred to the plating bath, under similar conditions. 3 or 4 Smee cells with plates 10x4 in. will generally suffice for the plating bath, and 4 or 5 similar cells for the whitening bath; twenty to thirty minutes in the plating bath is usually sufficient to plate the work properly. Articles of copper, brass or German silver to be plated should first be cleaned by boiling them for a few minutes in strong potash water to free them from traces of oil or grease and, after rinsing, in dilute nitric acid to remove any oxide and again thoroughly rinsed. It must not be touched by the hand after cleaning. Just before putting the work into the bath, dip it momentarily in strong nitric or a mixture of equal parts nitric and sulphuric acids and rinse quickly. After this treatment it is sometimes dipped for a moment in dilute aqueous mercurous nitrate solution and rinsed again. This has the effect of coating the clean metal with a film of mercury, which secures a perfect adhesion of the deposited silver.

2.—The Bath.—Water (soft), 1 gal.; cyanide of potassium (pure), 8 oz.; nitrate of silver, 5¼ oz.

Dissolve the nitrate of silver in a sufficient quantity of pure water (soft), and add to it gradually, with constant stirring, hydrocyanic (prussic) acid until all the silver has been precipitated as cyanide, which may be known by the formation of no cloud in a portion of the clear liquid when a drop of the acid is added to it. Avoid adding an excess of the acid. Throw the precipitate upon a fine cotton cloth filter, and as the liquid runs through wash the precipitate on the cloth several times with pure water. Dissolve the cyanide of potassium in the water, and stir in the cyanide of silver carefully removed from the cloth. If it does not dissolve in the liquid entirely, add more cyanide of potassium until it does, stirring continually. Let the impurities settle, and the bath is ready for use. Many electroplaters use a preliminary for silver "whitening" bath, which is the same composition, but contains less silver, more cyanide, and is worked with a somewhat stronger current.

The cleaned article in some cases is first dipped for a few moments in a solution of nitrate of mercury, 1 oz. in 1 gal. of water, and then in the whitening bath for a few minutes, and after brushing is transferred to the silver bath proper.

The vessels containing the cold bath are sufficiently high to allow about 4 in. of liquid above the immersed objects, whose distance from the bottom and sides should be nearly the same to give a regular deposit of metal at both ends of the object.

The upper ledge of the trough carries two brass rods all around, which do not touch one another, one above the other, so that other metallic rods placed transversely will rest upon the higher or lower series of rods only. The upper rods are connected with the zinc, the lower with the carbon or copper end of the battery, or with the corresponding poles of the dynamo-electric machine. The transverse rods resting upon the lower set support the silver anodes; those resting on the upper set, the work. The work suspended from an upper transverse is placed so as to face two anodes suspended from two lower transverse rods.

As the lower layers of the bath are apt to become denser (richer) than the upper, it is often necessary to reverse the articles during the operation to obtain a perfectly uniform thickness of deposit. For the same purpose small articles should be kept in motion as much as possible.

The deposit is finer and denser if obtained with a weak battery and long exposure than if a strong current is employed. A sufficient quantity of silver may be deposited in three or four hours, but it will be of much finer quality and more easily burnished if the work is left in the bath for twelve or fifteen hours with a few cells of battery.

When the articles, especially coppered iron, etc., have acquired a coherent film of silver, they are sometimes removed from the bath, and thoroughly scratch-brushed, cleansed in alcohol, or preferably in a hot silvering bath, thence again passed through the mercurial solution and finished in the cold plating bath.

The first scratch-brushing, which is not always necessary, obviates the tendency of certain alloys to assume a crystalline appearance and corrects the imperfections of the cleansing in process.

Should the anodes become black during the passage of the current, the solution contains too little cyanide. In this the deposit is adherent, but too slow; and the bath loses more silver than it can gain from the anodes.

If the anodes remain white during the passage of the current, the bath contains an excess of cyanide, and the deposit does not properly adhere; correct by adding cyanide of silver until it dissolves with difficulty.

When in good working order, the anodes present a gray appearance while the current is passing, becoming white when circuit is broken.

The specific gravity of the bath may vary from 5° to 15° Baume's hydrometer and still furnish good results.

Electro-silvering baths do not generally work so well when freshly prepared. If properly used and cared for, they improve by age. At first the deposit is often granulated bluish or yellowish.

It is customary to mix portions of an old bath with a freshly prepared one. Some platers introduce small quantities of ammonia instead to age the liquid.

Bisulphide of carbon in small quantities imparts a bright luster to plated articles. 1 oz. of the bisulphide is put into a pint bottle filled with a strong solution of the cyanide of potassium and silver, briskly shaken, and a few drops of this liquid poured into the bath occasionally until the work appears sufficiently bright. An excess of bisulphide must, however, be avoided, as it will spoil the bath.

What has been said about the arrangement of battery in articles of nickel and brass plating will also apply here.

3.—Deposits.—For electro-silverplating the double salt of silver and potassium cyanide is almost universally employed. The baths are used either hot or cold. The latter method is generally adopted for articles which require great solidity. The hot process is used for small articles, and is preferable for steel, iron, zinc, lead and tin, which have been previously electro-coppered. The hot baths are generally kept in enameled cast-iron kettles, and the articles are either suspended or moved constantly about in them. A somewhat energetic current is needed, especially when the articles are moved about in order to operate rapidly. A gray or black deposit indicates too strong a current, and when the surface becomes covered with bubbles of gas the same thing is indicated. The anodes are plates of silver or heavy silver foil. The wooden tanks for the cold baths are similar to those used in plating with copper and nickel, but should be very thoroughly coated on the inside with gutta percha.

Aluminum.—Lanseigne and Leblanc, in the *Journal de Pharmacie et de Chimie*, give the following formula. The article must be well cleaned with a dilute solution of an alkali (soda or potash) or with a weak solution of hydrochloric acid, and rinsed with water. The anodes must consist of the metal with which the plating is being done.

Silver nitrate, 2 parts; potassium cyanide, 4 parts; sodium phosphate, 4 parts; water, distilled, 100 parts.

Tin.

1.—The following is one of the best solutions of plating with tin by the battery process: Potassium pyrophosphate, 12 oz.; protochloride of tin, 4½ oz.; water, 20 oz.

The anode or feeding plate used in this bath consists of pure Banca tin. This plate is joined to the positive (copper or carbon) pole of the battery, while the work is suspended from a wire connected with the negative (zinc) pole. A moderately strong battery is required, and the work is finished by scratch-brushing.

2.—In Weigler's process a bath is prepared by passing washed chlorine gas into a concentrated aqueous solution of stannous chloride to saturation, and expelling excess of gas by warming the solution, which is then diluted with about ten volumes of water and filtered, if necessary. The articles to be plated are pickled in dilute sulphuric acid, and polished with fine sand and scratch-brush, rinsed in water, loosely armed with zinc wire or tape, and immersed in the bath for ten or fifteen minutes at ordinary temperatures. The coating is finished with the scratch-brush and whiting.

By this process iron—cast or wrought—steel, copper, brass, and lead can be tinned without a separate battery. The only disadvantage of the process is that the bath soon becomes clogged up with zinc chloride, and the tin salt must be frequently renewed.

3.—In Hern's process a bath composed of: Tartaric acid, 2 oz.; water, 100 oz.; soda, 3 oz.; protochloride of tin, 3 oz. is employed instead of the above. It requires a somewhat longer exposure to properly tin articles in this than in Weigler's bath. Either of these baths may be used with a separate battery.

Wastes.

Electroplating Solutions, To Recover from.—Gold solutions, usually cyanides, are boiled in a porcelain dish, sodic stannate added, and the boiling continued until all the gold has combined with the tin, forming a black precipitate. This precipitate is washed with water and dissolved in aqua regia. The solution of auric and stannic chlorides is carefully evaporated, diluted with distilled water, enough sodio-potassic tartrate added and warmed, when all the gold will be precipitated as a brownish yellow powder. For silver solutions it is only necessary to boil with sodic stannate.

Zinc.

Electro-deposition of.—For the electro-deposition of zinc solutions of the sulphate, ammonia sulphate, chloride and ammonia chloride may be employed, as also alkaline solutions, prepared by dissolving zinc oxide or carbonate in a solution of cyanide of potassium or caustic potassium; the deposit from either of these alkaline solutions is generally of very good quality, and if too strong a current be not employed the deposited metal is usually very tough.

COATING OF METALS BY OTHER PROCESSES

Copper Deposit By Dipping

This is seldom practiced except upon iron, as deposits thus obtained are generally wanting in lasting qualities, since, from the thinness of the coating, the iron is but imperfectly protected from atmospheric influences. If the iron is dipped in a solution of: Sulphate of copper, 3½ oz.; sulphuric acid, 3½ oz.; water, 1 to 2 gal.; it becomes covered with a coat-

HOT AND COLD COATING OF METALS
DEPOSITION BY SIMPLE IMMERSION, TABULAR EXAMPLES OF.

SOLUTION.	METAL.																		
	Antimony.	Arsenic.	Bismuth.	Brass.	Cadmium.	Cobalt.	Copper.	Gold.	German Silver.	Iron.	Lead.	Platinum.	Palladium.	Manganese.	Mercury.	Nickel.	Silver.	Tin.	Zinc.
Antim. terchloride	n	o	d	d	o	o	o	n	d	o	d	n	o	o	o	n	n	d	d
Bismuth chloride	n	o	n	n	o	o	n	n	n	d	d	n	o	o	o	o	o	d	d
Copper sulphate	n	o	n	o	o	o	n	n	o	d	d	n	o	o	o	n	n	d	d
Copper nitrate	n	o	n	o	o	o	n	n	o	d	d	n	o	o	o	n	n	d	d
Copper chloride.	n	o	d	o	o	o	n	n	o	d	d	o	o	o	o	n	n	d	d
Copper dichloride.	n	o	n	o	o	o	n	n	o	n	n	n	o	o	o	n	n	n	d
Gold terchloride	d	d	d	d	d	d	d	n	d	d	d	d	d	d	d	d	d	d	d
Gold double cyanide	n	o	n	d	o	o	d	n	d	n	n	n	o	o	o	n	n	n	D
Mercury nitrate	d	o	d	o	d	o	d	n	o	d	d	n	o	o	o	o	n	o	d
Mercurous salts.	d	d	d	d	d	o	d	o	o	d	d	o	o	o	o	o	d	d	d
Platinum chloride	d	d	d	d	d	d	d	n	d	d	d	n	o	o	d	d	d	d	d
Lead nitrate acetate	n	o	n	n	o	o	n	n	n	n	n	n	o	o	o	n	n	n	d
Silver nitrate.	d	d	d	d	o	o	d	n	d	d	D	n	o	d	o	d	n	D	d
Silv. alcoholic nitrate	d	o	d	d	o	o	d	o	d	n	o	o	o	o	o	o	o	d	d
Silv. double cyanide	n	o	n	d	o	o	D	n	d	n	D	n	o	o	o	n	n	n	D
Tin chloride	n	o	n	n	o	o	n	n	n	n	d	n	o	o	o	n	n	n	d
Zinc salts	n	o	n	n	o	o	n	n	n	n	n	n	o	o	o	n	n	n	n

REFERENCES.

d. Deposition. n. No deposition. o. Not observed. D. Quickly deposited.

ing of pure copper, having a certain adhesion; but should it remain there a few minutes, the deposit becomes thick and muddy, and does not stand any rubbing. Small articles, such s pins, hooks and nails, are thus coppered by tumbling them for a few moments in sand, bran, or sawdust impregnated with the above solution, diluted with three or four volumes of water.

GOLD

The metal employed for gilding is usually brass of a mixture of brass and copper. The following alloys have been recommended:

a.—Copper, 6 parts; brass, 1 part.

b.—Copper, 4 parts; Bristol brass, 1 part.

c.—Copper, 13 parts; old Bristol brass, 3 parts; tin, 14 parts.

1.—Mixtures employed in gilding by fire or by the wet processes.

Red Ormolu.—Potash alum, nitrate of potash, 30 parts of each; sulphate of zinc, 8 parts; common salt, 3 parts; red ocher, 28 parts; sulphate of iron, 1 part. Add to it a small proportion of annatto, madder, cochineal, or other coloring matter, ground in water or in weak vinegar.

Yellow Ormolu.—Red ocher, 17 parts; potash alum, 50 parts; sulphate of zinc, 10 parts; common salt, 3 parts; nitrate of potash, 20 parts.

Dead Luster for Jewelry.—Sulphate of iron, sulphate of zinc, potash alum, nitrate of potash, equal parts of each. All the salts are melted in their water of crystallization.

Hard Dead Luster for Clocks.—Water, 5 parts; nitrate of potash, 37 parts; potash alum, 42 parts; common salt, 12 parts; pulverized glass and sulphate of lime, 4 parts. The whole is thoroughly ground and mixed.

Soft Dead Luster for Smooth Surfaces and Figures.—Water, 5 parts; nitrate of potash, 46 parts; potash alum, 46 parts; common salt, 3 parts. The same treatment as the preceding mixture.

Green for Red Luster.—Bitartrate of potash, 65 parts; common salt, 25 parts; acetate of copper, 10 parts. The whole is ground together.

Wax for Gilding.—Oil, 25 parts; yellow wax, 25 parts; acetate of copper, 13 parts; red ocher, 37 parts. The whole is melted and stirred until cold.

2.—The following gilding solution will deposit a smooth and brilliant layer of gold on silver, brass, copper, etc.

Gold chloride, 20 parts; potassium cyanide, 60 parts; potassium bitartrate,

5 parts; prepared chalk, 100 parts; water, distilled, 100 parts.

Dissolve the gold chloride in a portion of the water and the potassium salts in the remainder. Mix the solutions and stir in the prepared chalk. The articles to be gilded should be rendered free from grease, oxidation, etc., and the mixture applied with a woolen rag and rubbed well on.

3.—The following formula, which appears in the *Zeit. Angew. Mikrosk.*, has been recommended: Crystallized pyrophosphate of sodium, 80 grams; hydrocyanic acid (12%), 8 grams; and crystallized gold chloride, 2 grams, are dissolve successively in 1 liter of distilled water, and heated to boiling. The object to be plated is well cleansed, attached to a copper wire, and immersed in the boiling fluid.

4.—We find the following in the *Zeitschrift fur angewandte Mikroskopie:* In 1,000 parts of distilled water dissolve in the following order: Crystalline sodium pyrophosphate, 80 parts; 12% solution of hydrocyanic acid, 8 parts; Crystalline gold chloride, 2 parts.

Heat to a boiling temperature, and dip the article, previously throughly cleaned, therein.

Brass and Copper.

1. The following formula has been adopted for water gilding, as it is termed. Fine gold, 6¼ dwts. Convert the gold into chloride and dissolve in 1 qt. of distilled water, then add 1 lb. bicarbonate of potassium and boil the mixture for two hours. Immerse the articles to be gilded in the warm solution for a few seconds, up to one minute, according to the activity of the bath.

2.—Another method of gilding brass and copper articles, by simple immersion, is to first dip them in a solution of protonitrate of mercury (made by dissolving quicksilver in nitric acid and diluting with water) and then dipping them into the gilding liquid. It is said that copper may be gilded so perfectly by this method as to resist for some time the corrosive action of strong acids. During the action which takes place, the film of mercury, which is electro-positive to the gold, dissolves in the auriferous solution, and a film of gold is deposited in its place.

Bronze, etc.

Small articles may be gilded by immersing them in the following solution, which must be used at nearly boiling heat. Caustic potash, 180 parts; carbonate of potash, 20 parts: cyanide of potassium, 9 parts: water, 1,000 parts. Rather more than 1½ parts chloride of gold is to be dissolved in the water, when the other substances are to be added and the whole boiled together. The solution must be strengthened from time to time by the addition of chloride of gold, and also after being worked four or five times, by the addition of the other salts in the proportions given. This bath is recommended chiefly for gilding economically small articles of cheap jewelry, and for giving a preliminary coating of gold to large articles, which are to receive a stronger coating.

Mercury Gilding.

Preparation of the Amalgam.—To prepare the amalgam of gold for the purpose of mercury gilding, weigh a quantity, of fine or standard gold and put in a crucible and heated to dull redness. The requisite proportion of mercury, 8 parts to 1 part of gold, is now added, and the mixture is stirred with a slightly cooked iron rod, the heat being kept up until the gold is entirely dissolve by the mercury. Pour the amalgam into a small dish about 3 parts filled with water and work about with the fingers under the water to squeeze out as much of the excess of mercury as possible. To facilitate this, the dish is slightly inclined to allow the superfluous mercury to flow from the mass, which soon acquires a pasty condition capable of receiving the impression of the fingers. Afterward sequeeze the amalgam in a chamois leather bag, by which a further quantity of mercury is liberated; the amalgam which remains after this final treatment consists of about 33 parts of mercury and 57 parts of gold in 100 parts. The mercury which is pressed through the bag retains a good deal of gold, and is employed in preparing fresh batches of amalgam. It is important that the mercury employed should be pure.

The Mercurial Solution.—To apply the amalgam a solution of nitrate of mercury is employed, which is prepared by dissolving in a glass flask 100 parts of mercury in 110 parts of nitric acid, of sp. gr., 1.33, gentle heat being employed to assist the chemical action. The red fumes which are given off must be allowed to escape into the chimney, since they are highly deleterious when inhaled. When the mercury is all dissolved the solution is to be diluted with about 25 times its weight of distilled water and bottled for use.

Applying the Amalgam.—The pasty amalgam is spread with the blade of a knife upon a hard, flat stone; the article, after being well cleaned and scratch-brushed, is treated in the following way: Take a small scratch brush of nitrate of mercury, then draw over the amalgam; pass the brush carefully over the surface to be gilded, repeatedly dipping the brush in the mercurial solution, and drawing it over the amalgam, until the entire surface is uniformly and sufficiently coated. Then rinse the article well and dry. The next operation is the evaporation of the mercury. For this purpose a charcoal fire, resting upon a cast iron plate, has been generally adopted a simple hood of sheet iron being the only means of protection from the injurious effects of the mercurial vapors. When the amalgamated article is rinsed and dried, it is exposed to the glowing charcoal, turned about and heated by degrees to the proper point; then it is withdrawn from the fire by means of long pincers or tongs. The article is then taken in the left hand, which should be protected with a leather glove, turned over the fire in every direction, and while the mercury is volatilizing the article should be struck with a long-haired brush to equalize the amalgam coating and force it upon such parts as may appear to require it. When the mercury has become entirely volatilized the gilding has a dull, greenish yellow color. If any bare places are apparent they are touched up with amalgam and the article again submitted to the fire, care being taken to expel the mercury gradually. The article is then well scratch-brushed; when it is of a pale, greenish color, heat it again to expel any remaining mercury, when it acquires the orange yellow of fine gold. If required to be bright it is burnished in the ordinary way.

Steel.

Gold leaf, chlorhydric acid, nitric acid, sulphuric ether.

Mix the two acids in the proportion of one part of nitric acid and three parts of chlorhydric acid; dissolve the gold leaf in it any evaporate till dry. The residue is to be dissolved in the smallest quantity of water possible. Then a volume of ether equal to three times the quantity of water is to be added. The liquor is to be shaken in a closely stoppered bottle until the layer of ether is colored yellow, and the water has lost all its color.

To employ this solution, immerse in it the steel object, previously polished. The surface will be immediately gilded. An imitation of damaskeen work may be obtained. It is sufficient to apply a varnish of wax to the parts before they are covered by the gilding.

NICKELING

Nickeling may be performed on all metals, cold, by means of nickelene by the Mistressey process, recently introduced in France, and any desired thickness deposited. It is said to be more solid than nickel.

First Bath. Clean the objects and take 5 kgm. of American potash per 25 liters of water. If the pieces are quite rusted, take 2 liters of chlorhydric acid per 1 liter of water. The bath is employed cold.

Second Bath.—Put 250 grammes of sulphate of copper in 25 liters of water. After dissolution add a few drops of sulphuric acid, drop by drop, stirring the liquid with a wooden stick until it becomes as clear as spring water.

Take out the pieces thus cleaned and place them in what is called the copper bath, attaching to them leaves of zinc; they will assume a red tint. Then pass them into the nickeling bath, which is thus composed:

Cream of tartar, 20 grams; sal ammoniac, in powder, 10 grams; kitchen salt, 5 grams; oxychlorhydrate of tin, 20 grams; sulphate of nickel, single, 30 grams; sulphate of nickel, double, 50 grams.

Remove the pieces from the bath in a few minutes and rub them with fine sand on a moist rag. Brilliancy will thus be obtained. To improve the appearance, apply a brass wire brush.

Brilliancy may be also imparted by means of a piece of buff glued on a wooden wheel and smeared with English red stuff. This will give a glazed appearance.

PLATINUM

In this new process, the metallic object is covered with a mixture of borate of lead, oxide of copper, and spirits of turpentine, and submitted to a temperature of from 250° to 330°. This deposit, upon melting, spreads in a uniform layer over the object. Then a second coat is laid on, consisting of borate of lead, oxide of copper, and oil of lavender. Next, by means of a brush, the object is covered with a solution of chloride of platinum, which is finally evaporated at a temperature of not more than 200°.

The platinum adheres firmly to the surface, and exhibits a brilliant aspect. If the deposit be made upon the first coat, the platinum will have a dead appearance. Platinizing in this way costs, it is said, about one-tenth the price of nickel plating.

Copper.

The appearance of platinum may be given to copper by immersion in a bath composed of 1¾ pt. hydrochloric acid, 7½ oz. arsenic acid, and 1¼ oz. acetate of copper. The article must be cleaned before immersion, and left in the bath till it has the color of platinum.

Silver.

Place some platinum in a small quantity of aqua regia or nitro-muriatic acid, and keep it in a warm place a few days; it will dissolve. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and muriatic acids. Add a little water, and it is ready for use. A dozen drops of this solution goes a long way in platinizing silver. The operation is performed in a small glass or beaker, covered with a watchglass to keep in the fumes, and placed in a little sand in a saucer, to equalize the heat.

SILVER

Silver is used to a great extent in plating other metals, to which it imparts not only its fine color, but also great resistance to outward influences.

There are a number of methods of silverplating, which may be distinguished: 1. Cold plating by rubbing. 2. Wet plating by means of boiling. 3. Mechanical plating by pressing or rolling. 4. Fire-silvering. 5. Contact plating. 6. Electroplating. The latter method is the one which at present is almost exclusively employed.

Cast Iron, To Silver.

1.—To silver cast iron, 15 gr. nitrate of silver are dissolved in 250 gr. water, and 30 gr. cyanide of potassium are added; when the solution is complete, the liquid is poured into 700 gr. water wherein 15 gr. common salt have been previously dissolved. The cast iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1.2 sp. gr. just before being placed in the silvering fluid.

2. A new process for silvering articles of iron is thus described. The article is first plunged in a pickle of hot dilute hy-

drochloric acid, whence it is removed to a solution of mercury nitrate, and connected with the zinc pole of a Bunsen element, gas carbon or platinum serving as the other pole. It is rapidly covered with a layer of quicksilver, when it is removed, washed, and transferred to a silver bath and silvered. By heating to 300° C. (572° Fah.) the mercury is driven off, and the silver firmly fixed on the iron. To save silver, the wire can be first covered with a layer of tin. One part of cream of tartar is dissolved in 8 parts of boiling water, and 1 or more tin anodes are joined with the carbon pole of a Bunsen element. The zinc pole communicates with a well cleaned piece of copper, and the battery is made to act till enough tin has deposited on the copper, when this is taken out and the ironware put in its place. The wire thus covered with tin chemically pure, and silvered, is said to be much cheaper than any other silvered metals.

Cold Plating. (See **Rubbing.**)

Dead Luster.

Mix 7 oz. white lead and 1 oz. white litharge, with linseed-oil varnish. Mix this mass with an oil varnish.

Desilvering.

The following is a liquid which will dissolve silver without attacking copper, brass, or German silver, so as to remove the silver from silvered objects, plated ware, etc. It is a mixture of 1 part of nitric acid with 6 parts sulphuric, heated in a water bath to 160° F., at which temperature it operates best.

Niello, or Nielled Silver.

This process somewhat resembles enameling, and consists essentially in inlaying engraved metal surfaces with a black enamel. The composition is made as follows: Put into the first crucible, flowers of sulphur, 750 parts; sal ammoniac, 75 parts. Put into the second crucible, silver, 15 parts; copper, 40 parts; lead, 80 parts. When this mixture is sufficiently fused, the alloy thus formed is added to the fused sulphur in the first crucible, which converts the metals into sulphides. The compound is afterward removed from the crucible and reduced to a fine powder. To apply the powder, it is mixed with a small qunatity of a solution of sal ammoniac. The entire surface of the engraved silver work is covered with the nielling composition; it is then placed in the muffle of an enameling furnace, where it is left until the composition melts, by which it becomes firmly attached to the metal. The nielling is then removed from the parts in relief, without touching the engraved surfaces, which then present a pleasing contrast in deep black to the white silver surfaces. This process is only applicable to engraved work.

Rubbing.

Cold Plating.—If certain silver compounds are brought into contact with other metals, such as zinc, iron, or copper, they will be decomposed, with separation of metallic silver; and this is the basis of a method of plating which consists merely in rubbing on a composition with a cork. Such a coating is not very durable, and only suitable for objects which are not to be submitted to any hard wear, such as the scales of thermometers and barometers.

1. One of the older formulas for cold plating gives the following mixture: Silver chloride, 3 parts; salt, 3 parts; washed chalk, 2 parts; potash, 6 parts.

This compound is applied to the metal with a piece of moistened leather or with a cork. The object must previously be made bright, and is to be finally polished, after rinsing.

The silver chloride is obtained by dissolving silver in nitric acid, and adding to the solution hydrochloric acid, as long as there is any heavy white precipitate, resembling flakes of freshly precipitated cheese. This precipitate is filtered off, washed with water until the water, tried with ammonia, is no longer colored blue, and then dried in a dark place and also kept in the dark. Silver chloride is decomposed by light, becoming purple and finally black.

2.—A fine even plating is produced by application of a paste consisting of 1 part of silver nitrate and 3 of potassium cyanide. This is to be rubbed on with a woolen rag, the object afterward washed, and rubbed bright with leather. It is best to wear gloves when doing this, as potassium cyanide is so very poisonous that if the smallest scratch on the hand is touched by it, dangerous or even fatal ulcers may be caused.

3.—Small objects, such as buttons, are easily silvered by rubbing with a composition consisting of 3 parts of silver chloride, 8 parts of tartar, and 1 of salt, made into a paste.

4.—In another method, 1 part of powdered silver, chemically prepared by precipitation of a silver solution with copper, is rubbed together, dry, with 2 parts of tartar and 2 of salt, the mixture is moistened with enough water to make a thin paste, and is rubbed on with the finger or with a compact, stiff brush. Bronze, copper, or brass objects will take, in this way, a very beautiful dull white silver coating.

5.—Make paste by thoroughly grinding in a porcelain mortar, out of the light: Water, 3 to 5 oz.; chloride of silver, 7 oz.; potassium oxalate, 10½ oz.; common table salt, 15 oz.; sal ammoniac, 3¾ oz. Or, chloride of silver, 3½ oz.; cream of tartar, 7 oz.; common salt, 10½ oz.; water, to form a paste. Keep in a covered vessel, away from the light. Apply with a cork or brush to the clean metallic (copper) surface and allow the paste to dry. When rinsed in cold water the silver presents a fine frosted appearance, the brightness of which may be increased by a few seconds' immersion in dilute sulphuric acid or solution of potassium cyanide. The silvering bears the action of the wire brush and of the burnishing tool very well, and may also be oxidized. Should a first silvering not be found sufficiently durable after scratch-brushing, a second or third coat may be applied. This silvering is not so adhering or white on pure copper as upon a gilt surface.

For the reflectors of lanterns the paste is rubbed upon the reflector with a fire linen pad; then, with another rag, a thin paste of Spanish white or similar substance is spread over the reflector and left to dry. Rubbing with a fine clean linen rag restores the luster and whiteness of the silvered surface.

The paste is sometimes mixed directly with the whiting and left to dry, or until nearly dry, then rubbed down as described.

6.—Nitrate of silver, 2 parts; salt, 2 parts; cream of tartar, 14 parts. Pulverize and mix.

7.—For thin plating dissolve in 10 or 12 drops of water and add nitrate of silver, 2 parts; cyanide of potassium, 6 parts. Rub on the object.

8.—One oz. of nitric acid is put in a glazed earthen vessel and placed over a slowly heating fire, and [illegible] it boils instantly the pieces of real silver are thrown in and dissolved immediately. When this is done a large handful of salt is put in, which will kill the acid. Then the paste is made by the means of common whiting. Clean the article to be plated and apply the paste with water and wash leather. Will keep for years.

9.—Silver nitrate, 15 grams; tartar, 15 grams; potassium cyanide (poisonous), 7 grams; ground chalk, 130 grams. The powder is moistened slightly and then vigorously rubbed on the article to be silvered.

10.—*Amalgam of Silver and Tin.*—Put into a mortar 2 parts of mercury, 1 of chemically precipitated silver powder, 1 of tinfoil, and rub until the metals are amalgamated, then mix with 6 parts of bone ash, and apply the compound with a moist rag to brass or copper; it can also be used for bronze, and gives a silvery coating, which is much finer and more durable than many kinds of wet plating.

11.—*Brass.*—The first essential is that the metal be chemically clean, which is best done by the use of dilute nitric acid, followed by a wash with clean water, and then with dilute aqua ammonia, drying in sawdust. If the metal be then rubbed with chloride of silver dissolved in water, and then washed and again dried in sawdust, the result will be fine. It should, however, be immediately lacquered in order to preserve the surface.

12.—*Imitation of Cold Silver Plating.*—Rub together equal quantities of mercury, tin, and bismuth, until amalgamated, and add one and a half times as much washed chalk. This compound, applied to brass, gives a silvery coating, lustrous, but not very durable.

Wet Plating.

Cold Method.—There are upon the market various fluids, called "silvering fluid," "eau argentine," etc., which impart to clean and bright metal objects, simply immersed in them, a brilliant but very thin silver coating. The following are given for these fluids:

1.—Silver carbonate, 1 part; sodium hyposulphite, 10 parts; water, 10 parts. The silver carbonate is obtained by pouring a soda solution into a solution of silver nitrate, the resulting precipitate to be washed and dried. Or it need not be dried, but simply put into a glass vessel with the crystals of sodium hyposulphite, where water is poured over it and the solution hastened by frequent stirring. The fluid is then poured off from the undissolved residue of the silver carbonate. The objects immersed in it are to be touched with a zinc rod.

2.—Dissolve 1 oz. crystals of silver nitrate in 12 oz. soft water, then dissolve in the water 2 oz. potassium cyanide. Shake the whole together and let it stand until it becomes clear. Have ready some half ounce vials and fill them half full of Paris white or fine whiting and then fill up the bottles with the liquid and it is ready for use. The silver coating is not as tenacious to the article as when electrolytically deposited. This is very poisonous, and should be handled with great caution—if at all.

3.—Boettger's Plating Fluid for Brass, Copper, Iron, and Steel.—Silver hyposulphite, 2 parts; ammonium chloride, 1 part; water, 20 parts.

The silver hyposulphite is obtained by dissolving silver nitrate in water, adding ammonia until the resulting precipitate again dissolves, then adding a concentrated solution of sodium hyposulphite and also alcohol. The silver hyposulphite which will be precipitated is to be well washed and dried. The fluid must always be freshly prepared, since the silver hyposulphite, which can be preserved dry, soon decomposes in solution. Iron and steel can be plated with this fluid directly, without previous copperplating, and one advantage which it possesses is that it is free from the poisonous potassium cyanide.

4.—Brass.—Silver nitrate, 29 grams (29 parts); potassium cyanide, 120 grams (120 parts); washed chalk, 30 grams (30 parts); water, 1 l. (1,000 parts).

5.—Kayser's Plating Fluid (Argentine).—Silver nitrate, 5.5 parts; sodium hyposulphite, 10 parts; ammonium chloride, 6 parts; washed chalk, 10 parts; water, 100 parts.

6.—Kurth's Plating Fluid.—Silver nitrate, 2 parts; ammonium chloride, 1 part; sodium hyposulphite, 4 parts; washed chalk, 4 parts; water, 40 parts. This fluid is suitable for copper, brass, bronze, or German silver.

7.—Schirtitz Argentine Water.—Silver nitrate, 11 parts; potassium cyanide, 60 parts; water, 750 parts; washed chalk, 11 parts. For use, 1 part of the compound (which should be kept in a dark-colored glass receptacle) is to be mixed with 2 parts of soft water and the objects laid in the fluid; large objects may be rubbed with a sponge or rag wet in it, rubbed, after silvering, with washed chalk and polished with soft leather.

8.—Zinc.—Silver nitrate, 10 parts; potassium cyanide, 25 parts; washed chalk, 100 parts; tartar, 10 parts; mercury, 1 part; water, 100 parts. This compound, like all which contain potassium cyanide, must be freshly prepared for use, thoroughly shaken, and applied with a brush. The silvering will take place quickly, and the object is to be afterward washed and brushed.

Hot Method.—Plating can be done by boiling with liquids whose composition is similar to those employed in cold plating. If, for instance, the objects to be silvered are put into a compound consisting of 6 parts of tartar, 6 of salt, and 1 of silver chloride, there will be obtained, after fifteen or twenty minutes' boiling, a beautiful and durable silver plating, which, however, is not very lustrous. If a brilliant luster is desired, the objects may be heated, on coming from the plating fluid, in a solution consisting of 3 parts of sodium hyposulphite in 32 of water, and 1 of sugar of lead in 16 of water. Black lead sulphide will be precipitated, and after ten or fifteen minutes' heating the objects will have a bright coating of silver. The heating temperature should be from 70 to 80° C.

TIN

Preparation for Tinning.

To prepare tin for tinning brass, copper and iron.—Melt the metal in a crucible which has previously been slightly warmed; and at the moment the metal begins to set, and when it is very brittle, pound it up rapidly, and sift when cold to remove any large particles.

Processes.

Perhaps the best and cheapest substitute for silver as a white coating for tableware, culinary vessels, and the innumerable articles of manufacture requiring such a coating, is pure tin. It does not compare favourably with silver in point of hardness or wearing qualities, but it costs very much less than silver, is readily applied, and easily kept clean and bright.

There are several methods in use by which small articles, wire, etc., of iron, copper, brass, zinc and composition, are tin plated. These are: 1. By contact with melted tin. 2. By tin amalgam. 3. By simple immersion. 4. By battery.

1.—*Contact Process.*—The contact process is that by which all sheet tin, or, more properly, tinned sheet iron, is produced. In tinning ho[illegible]ow ware on the inside, the metal is first thoroughly cleansed by pickling it in dilute sulphuric acid, and scouring it with fine sand. It is then heated over a fire to about the melting point of tin, sprinkled with powdered rosin, and partly filled with melted pure grain tin covered with rosin to prevent its oxidation. The vessel is then quickly turned and rolled about in every direction, so as to bring every part of the surface in contact with the molten metal.

The greater part of the tin is then thrown out, and the surface rubbed over with a brush of tow to equalize the coating. The operation is repeated, if necessary. The vessels usually tinned in this manner are of copper and brass, but with a little care in cleansing and manipulating, iron can also be satisfactorily tinned in this manner. The vessels must be hot enough to keep the tin contained in them fused.

2.—*Amalgam Process.*—The amalgam process is not used so much as it was formerly. It consists in applying to the clean and dry metallic surface a film of a pasty amalgam of tin with mercury, and then exposing the surface to heat, which volatilizes the latter, leaving the tin adhering to the metal.

3.—*Immersion Process.*—The immersion process is best adapted to coating articles of brass or copper. When immersed in a hot solution of tin properly prepared the metal is precipitated upon their surfaces. One of the best solutions for this purpose is the following: Ammonia alum, 17¼ oz.; boiling water, 12½ oz.; protochloride of tin, 1 oz. The articles to be tinned, first throughly cleansed, are put into the hot solution until properly whitened.

4.—A better coating can be obtained by using the following bath, and placing the pieces in contact with a strip of clean zinc, also immersed: Bitartrate of potassium, 14 oz.; water (soft), 24 oz.; protochloride of tin, 1 oz. It should be boiled for a few minutes before using.

Brass.

Small articles of brass like hooks and eyes may be covered with a thin coating of tin by any of the following methods:

1.—Make a saturated solution of cream of tartar in boiling water; place the articles to be coated between sheets of tin, immerse in the liquid, and boil until a sufficient deposit has been obtained. The brass should be freshly cleansed by immersion in dilute acid and subsequent washing or otherwise, just before being submitted to the tinning operation. The articles after being coated are washed in water and brightened by being shaken with bran.

2.—Boil peroxide of tin with a strong, aqueous caustic potash solution, until the liquid is saturated with tin, and immerse the articles in this solution.

3.—Roseleur recommends the following method: Prepare a solution of chloride of tin in crystals, 6 parts; pyrophosphate of sodium, 60 parts; distilled water, 3,000 parts Place the articles on perforated zinc trays, immerse in the solution, and boil, stirring the contents occasionally to change the points of contact. The zinc trays are to be scraped clean after each operation to insure perfect contact in the next.

Castings.

1.—Cleanse the castings by pickling in dilute sulphuric acid (1 to 20 of water) and scouring with sand if necessary. Then boil them in concentrated aqueous solution of stannate of soda, with a quantity of granulated tin. To copper iron castings, clean the iron as above and tumble it for a few minutes in sawdust moistened with a solution of copper in two gallons of water made slightly acid with sulphuric acid. Wash immediately in hot water.

2.—To tin small castings, clean and boil them with scraps of block tin in a solution of cream of tartar.

Cold Process.—Take equal parts of quicksilver and block tin and melt them together. Mix also equal parts of muriatic acid and water. Apply the amalgam with a clean rag steeped in the acid mixture.

Copper, Retinning.

1.—Make the copper chemically clean by washing with a saturated solution of zinc in muriatic acid, the acid to be weakened with water to half strength after the dissolving of the zinc. Heat the copper vessel and pour in a small quantity of metal, of tin, 1 part, lead 1 part, and shake or tip the vessel until the tinning runs over the parts. Or, wipe the melted tin over the bare places with a cotton canvas pad.

2.—The best way to tin old copper utensils is to thoroughly clean them with sand and oxalic acid, and tin with a large copper soldering iron, using chloride of zinc and sal ammoniac (soldering fluid) for flowing the tin. It can also be done by heating the vessel and flushing melted tin over the surface, first sprinkling it with powdered rosin. You may succeed in this after a few trials.

Crystalline Appearance.

The following is the most approved method of producing this effect: The plate iron to be tinned is dipped into a tin bath, composed of 200 parts of pure tin, 3 parts of copper, and 1 part of arsenic. Thus tinned, the sheet iron is then submitted to the seven following operations:

a.—Immersing in lye of caustic potassa, and washing.

b.—Immersing in diluted aqua regia, and washing.

c.—Immersing in lye of caustic potassa, and washing.

d.—Quickly passing through nitric acid and washing.

e.—Immersing in a lye of caustic potassa, and washing.

f.—Immersing in aqua regia, and washing.

g.—Immersing in a lye of caustic potassa, and washing.

The coat of oxide must be entirely removed at each washing, and the last washing should be in hot water. The varnish recommended is copal in spirit.

Tacks.

A recommended process of tinning iron tacks is to triturate chloride of zinc with a large quantity of oil and heat it in an oscillating vessel. As soon as this has reached the proper temperature, throw in the tacks and the necessary quantity of metallic tin, and after a few seconds dip them out with wire gauze and cast them in water.

1.—A solution is first made by dissolving with the aid of heat, in an enameled pan, protochloride of tin (fused), 2½ grams; ammonia alum, 75 grams; water, 5 l. The chloride of tin is readily made by dissolving grain tin in hydrochloric acid, with the aid of heat, care being taken to have an excess of metal in the dissolving flask. When the bubbles of hydrogen gas which are evolved cease to be given off, the action is complete. If the solution be evaporated at a gentle heat until a pellicle forms on the surface, and the vessel then set aside to cool, needle-like crystals are obtained, which may be separated from the mother liquor by tilting the evaporating dish over a second vessel of the same kind. When all the liquor has thoroughly drained, it should in its turn be again evaporated, when a fresh crop of crystals will be obtained. The crystals should, before weighing, be gently dried over a sand bath. When the solution of tin and alum has been brought to a boil, the iron articles, after being well cleansed and rinsed in water, are to be immersed in the liquid, when they quickly become coated with a delicately white film of a dead or matted appearance, which may be rendered bright by means of bran in a revolving cask, or in a leathern bag shaken by two persons, each holding one end of the bag. To keep up the strength of the tinning bath, small quantities of the fused chloride of tin are added from time to time.

Zinc.

1.—It is quite an easy matter to tin zinc, as tin adheres well to this metal. The articles are first pickled clean and bright with sulphuric or hydrochloric acid, then dipped in melted tin, covered with a layer of grease.

2.—Sheets of zinc are tinned like sheet iron, by the English method, which is to dip the sheet, pickled and heated, into a tin bath, with a cover of tallow, and then into very hot melted tallow alone, in order that it may cool slowly and evenly.

3.—Large sheets of zinc may be tinned by laying them upon an iron plate, heated from underneath, strewing them over with powdered colophony or pouring on melted tallow, and then rubbing in melted tin with tow, as before described.

4.—Heavy zinc plate may be given a durable plating in the same way that lead is plated, except that the zinc plate is not usually cast upon the same table where the tinning is done, but is cast, and rolled once or twice, then laid upon this table and warmed. Good tinned sheet zinc is excellently well adapted to making the most durable roofing, gutters, water pipes, etc., and deserves more extensive use than it has yet had.

5.—Zinc articles can be very simply and easily tinned as follows: Prepare a mixture of 2 parts of tin chloride, 2 of purified tartar, 4 of water at 75° C. (167° F.), and enough of the finest sand to make a pulpy mass. Apply this with a sponge or brush to the articles. The tin coating will at first be dull gray, but rubbing with clay and sand will bring out a fine tin luster.

6.—Make a bath of distilled water, 1 gal.; pyrophosphate of soda, 3¼ oz.; fused protochloride of tin, ½ oz. A thin coat of tin can be obtained by simply dipping the zinc in the bath, and one of any thickness by the aid of the battery.

ZINC

Full instructions for Galvanizing are given in the Scientific American Supplement, Nos. 1645, 1646, 1704, 1705, 1731. For galvanizing iron wire see Scientific American Supplement, No. 1705.

1.—For galvanizing cast iron with zinc, first clean the castings thoroughly by immersing in a bath of 1 part muriatic acid, 2 parts water, for a few hours; wash thoroughly in hot water and scrub with brush and sand. Then dip in a solution of sal ammoniac and water, ¼ lb. to the gal., hot. Dry quickly and dip in the zinc bath.

2.—To galvanize sheet-iron work, dip in a bath of muriatic acid 1 part, water 4 parts; leave the work in long enough to break up the scale; clean with brushes or scrapers so that the surfaces shall be free from scale or dirt. Then dip in a fresh bath of muriatic acid and water, 1 to 4, with about 1 oz. sal ammoniac to the gal. of solution. Then dry quickly and thoroughly in a hot oven or on hot plates of iron and dip in the zinc bath. Never dip if any moisture remains among laps or rivets, for an explosion will ensue. Heat the zinc so that it will have a clear shining surface. Sprinkle a little powdered sal ammoniac upon the surface to clear it. Skim away the dross.

3.—Clean all scale, rust and dirt or oil from the surface, and if oily, by boiling in caustic soda, and then remove scale and rust by a bath of hydrochloric acid and water. If necessary a little scrubbing with a metallic brush, and then thoroughly rinse in hot water and dry quickly. After drying immerse in a bath of melted zinc, at the same time sprinkle a little powdered sal ammoniac upon the surface of the melted zinc to clear it. Judgment is required as to length of time for the immersion and temperature of the melted zinc. Very small work immersed but a few seconds.

Crystals.—Clean it perfectly with a solution of chloride of zinc, and you will find that the coating is already crystalline. Or use a wash of dilute nitric acid, 1 part of acid to 1 part of water, and wash in a stream of clean water.

Iron.

Electrolytic Method.—Perfectly bright iron, dipped in a solution of zinc vitriol, and exposed to a strong electrical current, becomes quickly coated over with pure zinc. The coating, however, is dull; to give the usual luster of zinc, the sheets are quickly heated to the melting point of zinc, cooled, and passed between smooth rollers.

Small Objects.—To galvanize small iron articles, such as chains, rings, hooks and nails, thereby protecting them from rust, they are first put into a vessel containing dilute sulphuric acid, in order to pickle them bright, then dried, and put into the melted zinc. The usual method is to lay the articles into a net or basket of strong wire, and to immerse this in the melted metal, shaking it around to make sure that all the pieces come in contact with the zinc. Aftr remaining two or three minutes in the zinc bath, they are removed and thrown into a little flame-oven, covered with powdered coal and brought to a red heat. The excess of zinc is hereby melted off, and collects in the lowest parts of the bottom of the oven. The articles are then drawn with rakes into the higher portions of the oven, moved around until the zinc coating has hardened, and the adhering coal powder is then rubbed off.

The zinc coatings on small articles are more durable if the objects are first lightly copperplated before galvanizing. The simplest way of doing this is to put them, after pickling, into a trough and pour over them a solution of one part of blue vitriol to ten of water; after having remained a few moments in contact with the fluid, they are removed, rinsed and thrown into the zinc bath. The thickness of the zinc coating varies according to the time during which the objects are left in contact with the fluid zinc; experiments have shown that in the case of galvanized sheet iron, the thickness of the layer varies from 0.006 to 0.043 millimeter, which corresponds to 45-300 gram of zinc per square meter of surface.

CHAPTER XI

GLASS

Bending Glass Tubes.

1.—Place the part where the curve is required in the flame of a spirit lamp or in an ordinary gas flame (the whole of the surface must be equally heated); when the glass begins to soften, a gentle pressure by the hands will give the necessary bend.

2.—Fill them with sand; this is necessary in three cases: when the tube is very wide, when the glass is thin, and when the curve is to be of a very long radius; in the latter case, the tube, filled with sand, is best heated over a large furnace with burning charcoal.

Blowing Glass.

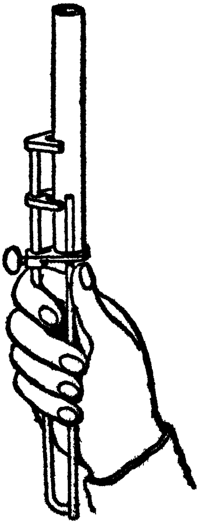
The technique of glass blowing is so comprehensive that it cannot be described in sufficient detail in a book of formulas. There are, however, two excellent little books on the subject which are profusely illustrated, and which are very inexpensive. To them the reader is referred.

Breaking. (See also **Cutting.**)

1.—Easy method of breaking glass to any required form. Make a small notch, by means of a file, on the edge of a piece of glass, then make the end of a tobacco pipe, or a rod of iron of about the same size, red hot in the fire; apply the hot iron to the notch, and draw it slowly along the surface of the glass in any direction you please; a crack will be made in the glass, and will follow the direction of the iron.

2.—Round glass bottles and flasks may be cut in the middle by wrapping around them a worsted thread dipped in spirits of turpentine, and setting it on fire when fastened on the glass.

3.—In breaking a glass tube—*e.g.*, a combustion tube—a small scratch is made with a file at the required place. At each side of the scratch, and about 1 to 2 mm. away from it, a small roll of wet blotting paper is laid around the tube. The free space between is then heated all around over a Bunsen burner, or, better still, over a small blowpipe flame. A clean and even fracture is thus obtained, exactly between the two rolls, without dropping water on the hot glass. The rolls are made by cutting two strips of filter paper sufficiently large to form rolls 1 to 2 mm. high and 2 to 4 cm. wide The strips are folded once, lengthway, laid on the table, moistened, flattened out, and then wrapped on to the tube, so that the fold lies nearest the file scratch, and fold lies accurately upon fold in the successive layers. The thickness of the rolls, and their distance apart, has, of course, to be varied according to the diameter of the tubes. Equally good results are obtained with the thinnest test tubes, the thickest combustion tubes, beakers, flasks and glass bell jars. In those cases, where the sides are slanting, as, for instance, with funnels, an obvious alteration in the construction of the paper rolls need only be carried out. A



Glass Tube Cutter

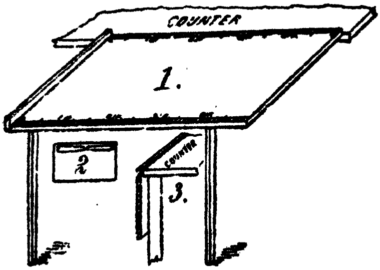
special cutter for glass tubes is sold by dealers in chemical apparatus, and is illustrated herewith.

Coloring.

Incandescent Light Globes. — (See HOUSEHOLD FORMULAS or the INDEX.)

Cutting Glass. (See also **Bending, Breaking, Drilling** AND **Boring**).

Board for Cutting Glass.—The accompanying drawing shows a home-made glass board that is used for measuring and cutting glass. The board, which measures 30 × 60 in., is fitted with grooves running along both sides, full length, that will just accommodate a cloth tape measuse (such as tailors use), leaving the measure perfectly level with the top of the board. The board is fastened to the counter or base shelf with hinges, so that it can be let down when not in use. It has two legs on the outside or front that are attached with hinges to permit of them being doubled up under the table when not in use. In cutting glass, lay a rule across the table, and see that the numbers correspond to the size you wish to cut the glass on both sides of the board. Fig. 1 represents the board ready for use. Fig. 2 shows the legs doubled up under the board, and Fig. 3 shows the board when not in use and hanging down. The board can be used as a table or working counter for other purposes.



Glass Cutting Table

Cutting—1.—To cut glass well a fine diamond should be used, and considerable skill is required in its use. The file and the red-hot poker are also efficient means of cutting glass, the crack following the hot iron.

2.—Bottles.—a.—This method consists in the use of what in German is called "sprengkohle," cracking cold. The "sprengkohle" is made of finely ground limewood charcoal. The coal powder is transformed by means of sufficient gum tragacanth and water into a dough or paste, out of which small cylinders of the size of a pencil are made by rolling between two small pieces of board. Such a cylinder of sprengkohle, ignited at one end, glows slowly. Such sprengkohle may be bought at stores for chemical and physical necessities. Now as for the use of the sprengkohle, it is as follows: Put a drop of water on the spot where the crack is to begin. Make a short incision with a three-edged file. Wipe the water away. Touch the incision with the glowing "sprengkohle," blowing on it if required. After a few seconds the glass will crack for a length of ¼ to 1 in. If now you move the sprengkohle slowly the crack follows it wherever you please.

3.—Holes, Large, To Cut.—Bore a hole in the center by means of a hard steel drill moistened with turpentine; cut the circle with a good glazier's diamond, guided by a small piece of copper wire centered in the hole just bored, and by means of cuts radiating from the center to the circumference divide the circle into numerous small sectors. Then, with a small piece of metal, tap the glass on the posterior side gently, following each cut throughout its extent. When this has been properly done fasten a piece of putty over the area of the circle on the cut side of the glass, and, while holding the putty, tap the glass on the other side firmly in the center of the circle. Too much pressure on the diamond will cause it to scratch, without cutting the glass.

Carbon Points for Splitting Glass.—1.—Gum arabic, 10 dr.; water, 3 oz.; tragacanth, powdered, 4 dr.; hot water, 8 oz.; storax, 2 dr.; benzoin, 2 dr.; alcohol, 91°, 9 dr.; powdered charcoal, 3 to 3½ oz. Dissolve the gum arabic in the cold water and mix it with the paste made from the tragacanth and hot water. To the mucilage add the rosins, dissolved in the alcohol, and enough finely powdered charcoal to form a mass to be rolled into cylinders of suitable length, and about 4-10 of an in. in diameter. While rolling the sticks, powdered charcoal is employed to prevent adhesion. When thoroughly dry, the pencils are ready for use, and are managed as follows: One end is sharpened like a lead pencil, and ignited; then, the glass having been scratched with a diamond, the heated and glowing point of the pencil is carried close to the glass in the direction in which it is intended to split it.

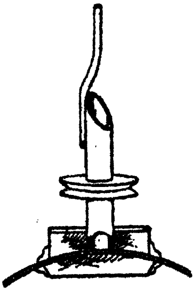
2.—The following receipts produce a pencil burning more rapidly than the above: Gum tragacanth, 1 dr.; hot water, 10 dr.; acetate of lead, 3 dr.; finely powdered charcoal, 6 dr. Proceed as formerly.

3.—Sticks of willow or poplar, or any soft wood of about the thickness of a finger, are thoroughly dried, and immersed for about 7 days in a concentrated solution of sugar of lead. When dry they are ready for use, and burn quite readily and evenly.

Cracking Coal for Cutting Glass.—Powdered charcoal, 90 parts; niter, 2 parts; benzoin, 1 part; powdered tragacanth, 2 parts. Mix in fine powder, mass with water, roll into pencils, and dry. Let one of these, when ignited pass slowly over the glass, and cause a drop of water to fall in the hot parts, when it cracks. The crack may be led in any desired direction by means of the turning pencil.

Drilling and Boring Glass.

1.—In the *Scientific American* these directions are given: Make a solution of 1 oz. of camphor, 1½ oz. of spirits of turpentine and 3 dr. of ether. Keep the end of the drilling tool wet with this fluid. The sharp corner of a freshly broken point of a file is one of the best drilling tools for this purpose.



Boring Glass with a Tube

2.—To drill a ¼-in. hole in a glass shade, make a hole in a piece of wood or metal of the size that you desire to drill in the glass. Fasten it with beeswax upon the glass for a guide. A piece of brass or copper tubing, quite thin, is supplied with emery (No. 100) and water and twirled between the fingers or with a bowstring. This will cut a hole in a few minutes. You can feed the emery and water a little at a time through the tube. The sketch will give an idea as to the principle.

3.—Can be done with a hard drill and spirits of turpentine—a tedious and uncertain process, and only for small holes. A diamond drill is much better and cheaper, if there are many holes to drill. If large holes are wanted, from ¼ to 1 in., or larger, prepare a piece of thin tubing, of brass or copper, of the required size of hole, of 1 or 2 in. in length, with small spindle and grooved pulley attached, something after the style of the watchmaker's bow drill. Fasten upon the plate of glass, at the point to be drilled, a ring of metal or wood for a guide to keep the tubular drill in its place until the cut is started sufficiently to steady the cutter. Lay the glass plate horizontally, and work the drill perpendicularly with the bow, using one hand to steady the upper end of the drill stock. Feed emery (about No. 90) and water into the open end of the tube as fast as required. In a very short time you will cut a disk out of the plate.

4.—For drilling holes in glass, a common steel drill, well made, and well tempered, the *Glassware Review* claims to be the best tool. The steel should be forged at a low temperature, so as to be sure not to burn it, and then tempered as hard as possible in a bath of salt water that has been well boiled. Such a drill will go through glass very rapidly if kept well moistened with turpentine in which some camphor has been dissolved. Dilute sulphuric acid is equally good, if not better. It is stated that at Berlin glass castings for pump barrels, etc., are drilled, planed and bored like iron ones, and in the same lathes and machines, by aid of sulphuric acid. A little practice with these different plans will enable the operator to cut and work glass as easily as brass or iron.

5.—The following directions were contributed to *Design and Work* by an optician: First make a saturated solution of camphor in spirits of turpentine; then make a spear-shaped drill he size of the hole required; heat the drill to a white heat, and plunge into mercury, and it will then be very hard; sharpen on an oilstone, knock drill in a bradawl handle, dip the end of drill into the above solution, and work it as if you were working it through wood. It is no use fixing the drill in a drillstock, because the motion all one way will not do. Keep the drill well moistened with the solution, and sharpen it when blunt. A file, dipped into the solution, will file the hole larger and will not get blunt.

6.—Small, rough, refuse diamonds, set

in the end of a tin tube, make effective drills for glass.

Etching.

In the opaque etching of glass it has hitherto been thought necessary to use certain expensive fluorine salts in the preparation of etching solutions. It has been discovered by A. Lainer that comparatively cheap etching can be prepared. In Dingler's *Polytechnisches Journal*, Lainer gives two recipes which obviate the use of the more expensive fluorine salts.

1.—Two solutions are first prepared: (a) Consisting of 10 grams of soda in 20 grams of warm water; (b) consisting of 10 grams of potassium carbonate in 20 grams of warm water. Solutions (a) and (b) are now mixed, and to the mixture is added 20 grams of concentrated hydrofluoric acid, and afterward a solution (c) consisting of 10 grams of potassium sulphate in 10 grams of water is added.

2.—This recipe contains the following ingredients: Water, 4 c.c.; potassium carbonate, 1 13 grams; dilute hydrofluoric acid, 0.5 c.c.; hydrochloric acid, 0.5 c.c.; potassium sulphate, 0.5 c.c. This mixture is treated with hydrofluoric acid and carbonate of potassium until it produces the required degree of opacity on being tried upon a piece of glass.

3.—But it appears that there is a still simpler process than either of these. It was invented by Herr Kampmann, of Vienna. In preparing an opaque etching fluid, Kampmann uses a wooden vessel, the iron fittings of which are protected from the corrosive action of the acid fumes by a layer of asphaltous material. This vesel is filled to about one-fifth of its contents with strong hydrofluoric acid, which is then partially neutralized by cautiously and gradually adding some crystals of soda; more soda is added, and the mixture is stirred with a small wooden rod. The point at which the neutralization of the acid should cease is indicated by the mixture frothing and becoming sufficiently viscid to adhere to the stirring rod. It is, perhaps, hardly necessary to say that the acid fumes are highly injurious, and that this process should be carried on in the open air, in order to allow the vapor to pass rapidly away. The most hygienic and satisfactory process of all would be to carry on the operation in a draught cupboard. The contents of this wooden vessel now consist of sodium fluoride and the unneutralized hydrofluoric acid. This mixture is now transferred to a wooden tub, and diluted with from 5 to 10 times its volume of water, according to the degree of dilution that is desired. It is objectionable to use this mixture in a too highly concentrated condition, for then the etched surface of the glass is irregular, coarse-grained, and apparently strewn with tiny crystals; if, on the other hand, the dilution be too extreme, the etched surfaces will be transparent instead of opaque. Either of these two conditions of the etching fluid can easily be remedied; for, if it be too strong, water must be added; and if too weak, a small quantity of hydrofluoric acid, partially neutralized with soda, must be mixed in.

4.—A good recipe for preparing a small quantity of this etching fluid is the following: Commercial hydrofluoric acid, 240 c.c.; powdered crystallized soda, 600 grams; water, 100 c.c. These etching fluids are best used by taking the following precautions: The glass is first thoroughly cleansed from all impurities, and is then provided with a rim of wax composed of the following ingredients: Bees wax, tallow, colophony and powdered asphalt, kneaded together. The rim prevents the acid from spreading over those parts of the surface which it is not desired to etch. The glass is now etched for a few minutes with an ordinary etching solution (H.F.—1 : 10), which is then poured off, the surface being afterward washed with water and wiped as dry as possible with a piece of sponge. The surface is now ready for the opaque etching fluid, which is poured on till it forms a thick layer. The operation is allowed to progress for an hour, when the liquid is poured away and the surface washed with water. Water is further allowed to stand on the glass until a thin film of silicate is observed to form; this film is then brushed off, and the surface finally cleansed with water, and the wax removed. By varying the action of this opaque etching fluid or paste, various degrees of opacity may be produced, and if the opacity be greater than that which is desired, the surface can be cleared to any extent by using the etching solution of hydrofluoric acid.

5.—Fancy work, with ornamental figures, lettering and monograms, are most easily and neatly cut into glass by the sandblast process. Lines and figures on tubes, jars, etc., may be deeply etched by smaring the surface of the glass with beeswax, drawing the lines with a steel point, and exposing the blass to the fumes of hydrofluoric acid. This acid is obtained by putting powdered fluorspar into a tray made of sheet lead, and pouring sulphuric acid on it, after which the tray is slightly warmed. The proportions will, of course, vary with the purity of the materials used, fluorspar (except when in crystals) being generally mixed with a large quantity of other matter; but this point need not affect the success of the operation. Enough acid to make a thin paste with the powdered spar will be about right. Where a lead tray is not at hand, the powdered spar may be poured on the glass and the acid poured on it, and left for some time. As a general rule, the marks are opaque, but sometimes they are transparent. In this case, cut them deeply and fill up with black varnish, if they are required to be very plain, as in the case of graduated vessels. Liquid hydrofluoric acid has been recommended for etching, but is not suitable, as it leaves the surface on which it acts transparent. The agent which corrodes the glass is a gas which does not remain in the mixture of spar and acid, but passes off in the vapor. The following formula has been published under the title of "Etching Ink": Ammonium fluoride, 2 dr.; barium sulphate, 2 dr. Reduce to a fine powder in a mortar, then transfer to a lead dish, and make into a thin writing cream with hydrofluoric acid (some make use of fuming sulphuric acid). Use a piece of lead to stir the mixture. The "ink" may be put up in bottles coated with paraffine, which can be done by heating the bottle, pouring in some melted paraffine, and letting it flow all around. The writing is done with a quill, and in about half a minute the ink is washed off. Extreme caution must be observed in handling the acid, since, when brought in contact with the skin it produces dangerous sores, very difficult to heal. The vapor is also dangerously poisonous when inhaled.

6.—Mix in a lead flask 30 parts of ammonium fluoride, 15 parts of distilled water and 6 parts of pure sulphuric acid; warm to 40° C.—but not higher—and add, after cooling, 6 parts of strong hydrofluoric acid and 1 to 2 parts of gum arabic in solution. Close the flask with a well fitting lead stopper. For particularly delicate drawings the quantity of gum arabic should be increased. Steel pens or goose quills may be used.

7.—Sodium fluoride, 36 parts; potassium sulphate, 7 parts; distilled water, 500 parts. Mix.

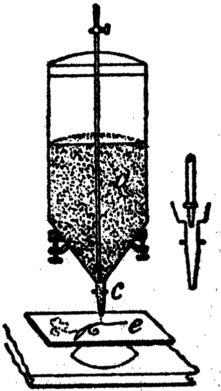
8.—Zinc chloride, 14 parts; distilled water, 500 parts; acid hydrochloric, 65 parts. Mix. Dissolve in separate vessels, and mix the solutions only when required for use. Write with a clean quill pen, being careful not to get too much of the liquid on the pen, as there is danger of blotting. The writing or etching appears in the course of a half hour.

9.—Commonly used for etching glass tumblers: Sodium fluoride, 1 oz.; glacial acetic acid, 10 dr.; water, 25 oz. Dissolve the sodium fluoride in water and add the acetic acid. The article to be etched is first coated with etching varnish, which is scratched off where a pattern is desired, and then immersed in the solution. The fluid is sometimes applied by means of a rubber stamp.

10.—Ammonium fluoride, 10%; barium sulphate, 10%; hydrofluoric acid, fuming, enough. Use enough acid to decompose the ammonium fluoride.

11.—Ammonium fluoride, 10%; barium sulphate, 30%; water, enough. This is made into a semi-liquid mixture, and may be applied with a common pen.

12.—Sodium fluoride, 0.72%; potassium sulphate, 0.14%; water, 240%. Make, and add to the foregoing, another solution, consisting of zinc chloride, 0.28%; hydrochloric acid, 40%; water, 40%. At the end of half an hour the design should be sufficiently etched.



Sandblasting Outfit

13.—Sandblasting Process.—The process here described consists in corroding glass by violently projecting sand upon its surface by means of a current of air or steam. The apparatus used is very simple, and is shown in our engraving. Well dried sand, contained in the cylindrical vessel, *a*, is allowed to flow in a continuous manner through the tube, c, whose length and inclination can be altered at will so as to regulate the fall of the sand. The tube conveying the current of air or steam terminates just above this spout, in a nozzle containing a series of fine holes. The sand, urged on by the jet, is thrown violently against the glass plate, *e*, or other body placed withing its range, and thus exerts a corroding action. By varying the quantity of the sand, the volume and velocity of the current, as well as the diameter of the jet, more or less rapid effects are produced. In engraving on glass, very little pressure is needed, the current from the bellows of an enameler's lamp being quite sufficient. In this way the divisions on graduated tubes, the labels on bottles, etc., can easily be engraved in laboratories with but little trouble. The portions of the glass which are to remain clear are covered with paper, or with an elastic varnish, these substances being sufficiently exempt from the corroding action of the sand.

14.—*Etching Glass by Means of Glue.* —a.—Certain substances adhere to glass with such tenacity, that, upon being abruptly separated, vitreous scales are often detached. This fact, Professor Cailletet says, in *La Nature*, he noticed a long time ago, while studying a process that should permit the soldering of glass to metals. The method of soldering then discovered is employed for adapting cocks or other metallic fittings to tubes designed to conduct gases under high pressures. In order to solder a piece of metal to a glass tube it suffices to silver the latter in order to render it a conductor of electricity, and then to deposit upon the silvered portion a ring of galvanic copper, to which any metal whatever may be soldered with tin. The galvanic copper thus deposited adheres so tenanciously to the glass that, upon being detached, flakes of glass are removed at the same time. Silicate of soda, which is often used for uniting two pieces of glass, exhibits the same phenomena; but the detaching of the surface of glass objects becomes particularly easy when either common glue or isinglass is employed.

Cover a piece of ordinary or flint glass with a coat of glue dissolved in water; the glue, upon contracting through the effect of desiccation, becomes detached from the glass, and removes numerous scales of varying thickness. The glass thus etched presents a decorative design that resembles the flowers of frost deposited upon window panes in winter. When salts that are readily crystallizable, and that exert no chemical action upon the gelatine, are dissolved in the latter, the figures etched upon the glass exhibit a crystalline appearance that recalls fern fronds. Hyposulphite of soda and chlorate and nitrate of potash produce pretty nearly the same effects. A large number of mineral substances are attacked by gelatine. What is called "toughened" glass is easily etched, and the same is the case with fluorspar and polished marble.

This etching of glass and different mineral substances by the action of gelatine may be employed for the decoration of numerous objects. The process is as follows: Dissolve some common glue in ordinary water, heated by a water bath, and add 6% of its weight of potash alum. After the glue has become perfectly melted, homogeneous, and of the consistency of cyrup, apply a layer, while it is still hot, to a glass object by means of a brush. If the object is of ground glass, the action of the glue will be still more energetic. In about half an hour apply a second coat, in such a way as to obtain a smooth, transparent surface, destitute of air bubbles. Now leave the object to itself, and after the glue has become so hard that it no longer yields to the pressure of the fingernail (say in about 24 hours), but the article in a warmer place, for example, in the kitchen range, in which the temperature must not exceed 105° F. Allow to remain a few hours, and when the object is removed the glue will detach itself with a noise, and remove with its numerous flakes of glass. All that the piece then requires it to be carefully washed and dried. The designs thus obtained are not always the same, the thickness of the coat of glue, the time of desiccation, and various other conditions, seeming to act in such a way as to modify the form and number of the flakes detached.

It is indispensable to employ glass objects of adequate thickness, since in covering what is called "muslin" glass with a layer of glue the mechanical action that it has to support during the desiccation is so powerful that it will break with an explosion. Glue, therefore, must not be allowed to dry in glass vessels, since they would be corroded and broken in a very short time.

b.—Few trade secrets have been kept so well from the knowledge of the general public as the process of producing crystalline or chipped decorative glass. The first necessity in carrying out this process is to have the glass which is to be ornamented ground either by means of the sandblast or by the more troublesome means of grinding by hand. This is done by rubbing a stone with a flat side over the glass till it has lost its polish and become translucent. A thin layer of emery, kept wet with water, will facilitate the grinding, which should be as coarse as possible, and for which reason grinding done by the sandblast is preferable. After the glass has been found it should be kept scrupulously clean. Great care should be exercised that the surface is not touched by the hands. Any trace of grease is very apt to make the results uncertain. If the glass has, however, become contaminated, it may be cleaned with very strong ammonia, although glass which it has been necessary to clean is apt to be rather unreliable. Good glue is placed in sufficient water to cover it, and allowed to soak for 24 hours. If the water is absorbed during the soaking, more may be added. It is then liquefied over a water bath, and is then ready to use. In practice, it makes considerable difference which kind of glue is used. By repeated experiments it has been found that Irish glue is the best for the purpose. A wide brush is dipped in the glue and applied to the glass. The coating should be a thick one, otherwise it will not be strong enough to do the work required. When the plates are coated they may be placed in racks, and the temperature of the room raised to 95 or 100° F. They are permitted to remain at this temperature till they are perfectly dry, which will be in 10 to 20 hours.

A. Glass Vessel Etched by the Action of Glue and Alum

B. Vessel Etched by Pure Glue

It is at this stage that the uncertain character of the glue shows itself. Under certain circumstances the glue will begin to crack and rise of itself, without any more manipulations; but generally it will require to have a stream of cold air suddenly strike it. If the plate is perfectly dry at this period, and of sufficient thickness, the top surface of the glass will be torn off with a noise resembling the crack of a toy pistol. Sometimes the pieces of glue will leap 2 or 3 in. in the air, and may even fly into the eyes and injure them. To guard against this it is customary for the workmen to wear a pair of spectacles fitted with plain glass. The glue will come off sometimes at the least expected times, notably if the plate with dried glue is being carried from one room to another. Plates which have shown a decided disinclination to chip have manifested a remarkable and unexpected activity, and have jumped into the face of the person carrying them, in such a manner as to cause him to drop them. The strength of the glue is very extraordinary. If the glass has been coated on the hollow or belly side of the glass, the slight leverage thus obtained is almost sure to break it, especially if the glass be single strength.

C. Toughened Glass Vessel Etched by Glue and Hyposulphite of Soda

Even plate glass is not unfrequently broken.

The result of the operation described may be either a design resembling ferns of various shapes and sizes, or it may be a circular design, exhibiting narrow, feathery appearances; or, if unsuitable glue has been used, it may be of a nondescript appearance. If, after the glue has been applied, but before it has become any more than set, a piece of stout paper is pressed over it, and it is allowed to dry in this way, the glass will have less the appearance of feathers, but will be much coarser, and larger pieces will be removed.

Some very elegant designs may be produced by submitting the glass once more to the same operation, covering it as before, and allowing the glue to chip This is known by the name of double chip. If the glass was covered with the small circles in the first place, the second time it will have an appearance very much resembling shells, and for this reason this has been called shell chip.

If, instead of using ordinary glass, colored glass is employed, pretty and original effects may be obtained. The glass may be either colored clear through, or it may have only a thin coating on one side. In the latter case, in some places the entire layer of colored glass will be removed, and in other places only a very little, and will, therefore, give all the gradations between those two extremes. Glass which has been treated in this way may be silvered and gilded, and thereby made still more remarkable in appearance.

Extremely elegant effects may be obtained by what is known as "chipping to a line." The design is ground in the glass by the ordinary sandblast process. After the glass has passed through the machine the protective coating (wax is generally used) is not removed, but is left on to keep the glue off those parts which are not intended to chip. The glue is then applied in a thick layer to the ground portion, and the process is carried on as usual.

Frosting Glass.

1.—Rub over with a little bag of muslin filled with fine sand, powdered glass, or grindstone grit, and water. Some sand may be placed directly on the glass.

2.—Clean the windows thoroughly, and moisten with hydrofluoric acid. When frosted enough, wash thoroughly.

3.—Make a saturated solution of alum water, and wet the glass with the liquid. It is advisable to have the glass in a horizontal position, as the solution is not likely to drain off. The more slowly it is cooled the more perfect the crystals will be. If desired, the alumn solution may be colored with cochineal, and, of course, the more solution used the thicker will be the crystals.

4.—Dissolve 2 tablespoonfuls of Epsom salts in 1 pt. of lager beer, and apply the brush

5.—Sandarach, 18 dr.; mastic, 4 dr.; ether, 4 oz.; benzine, 16 to 18 oz. This mixture is to be painted on the glass.

6.—Frosted glass may be ornamented as follows: Choose some pretty pattern of lace curtains, lay it upon thin paper, and then with a pencil trace the outlines. After making as many layers as you require patterns, cut out the designs at one time through the several layers of paper with sharp scissors. Fasten the pattern with tacks to the frame around each pane of glass you wish to decorate. Tie up a piece of putty in a piece of thin muslin, leaving enough of the latter to hold instead of a handle. With this dabble all over the part of the glass which the pattern leaves bare. When the pattern on the glass is dry remove the paper and varnish the glass.

7.—Dip a piece of flat marble into glass-cutter's sharp sand moistened with water; rub over the glass, dipping frequently in sand and water. If the frosting is required very fine, finish off with emery and water.

8.—As a temporary frosting for windows, mix together a strong, hot solution of epsom salt and a clear solution of gum arabic; apply warm.

9.—Use a strong solution of sodium sulphate, warm, and when cool wash with gum water.

10.—Daub the glass with a lump of glazier's putty, carefully and uniformly, until the surface is equally covered. This is an excellent imitation of ground glass, and is not disturbed by rain or damp.

Electric Lights, To Frost.—(See HOUSEHOLD FORMULAS.)

Mirrors.—a.—In dressing the mirror, first clean it, and have it perfectly dry. A very pretty and pleasing effect is obtained by the use of a liquid called "bottled frost." This, when applied to a mirror, and left to dry, will form in many shapes, all radiating from a focus. This frost can be made in the following manner: Sour ale, 4 oz.; magnesium sulphate, 1 oz. Put on the mirror with a small, clean sponge, and let dry. It is now ready for the artist, and he may choose his own colors and subject.

b.—Make a saturated solution of magnesium sulphate in soft water, somewhat warmer than the surrounding atmosphere. Dissolve sufficient dextrine to make a syrupy liquid, and add this to the solution of magnesium sulphate. Filter quickly through thin muslin, and apply the filtrate to the surface of the mirror, using a sponge, and applying the liquid plentifully. Let stand, and in the course of 15 or 20 minutes the mirror will be covered with a magnificent crop of flower-like crystals, resembling the "ice flowers" of winter, which adhere firmly to the glass. These may be made to last indefinitely by giving them a coating of shellac dissolved in alcohol (the solution must be thin). This should be done, however, only during a long spell of dry weather. Beautiful and artistic effects, it is said, are produced by dissolving in a portion of the saline solution water-soluble anilines, which thus produce colored crystals.

Gilding Glass.

1.—Thoroughly clean the glass, then take some very weak isinglass size, and while warm float the glass where you intend the gold to be laid, with the size and a soft brush; then lay the gold on with a gilder's tip, previously drawing it over the hair of your head to cause the gold to adhere to it. Tilt the glass aside to allow the superfluous size to run away, then let it dry, and if it does not look sufficiently solid upon the face, give another layer of gold the same way. Where the black lines are to show, take a piece of pointed firewood, cut to the width the lines are needed, and with a straightedge draw a line with the piece of wood, which, if made true and smooth, will take the gold off clean, and so square and sharpen up all the edges, lines, etc. When this is done, give a coat of Brunswich black thinned with a little turps, and the lines will show black, and it will preserved the gold. Try a small piece first, so as to get all in order.

2.—The proper flux is anhydrous borax; the real gilding is effected by the aid of heat. For this purpose a solution of gold in aqua regia (chloride of gold) is precipitated by potash or green vitriol —a finely divided powder (brown) consisting in metallic gold. This is washed, dried and rubbed up with the flux (anhydrous borax). Mix the same with oil of turpentine or gum water; apply with a brush. When heated in the muffle, the volatile oil escapes; the gum consumed, the borax melts and firmly attaches the gold to the surface of the vessel.

3.—Gold powder is prepared by rubbing down gold leaf with a little honey or thick mucilage or gum fluid in a porcelain dish until the gold is completely transformed into powder, after which the honey or gum, by repeated additions of warm water and pouring it off again, is washed away. The gold powder is then mixed with a strong borax solution, with which mixture the pattern is traced. When it is dry, place the glass in an oven and expose it to very considerable heat. This causes a sufficient amalgamation of the borax and the glass, so that the gold is firmly attached to the latter.

Grinding Glass Tube.

It is very easy to true the interior of glass tube by chucking same (cemented hot by pitch) into a true hole bored by a slide rest in a wooden carver's chuck, attached to a lathe face plate. Then grind out with fine emery the interior by sliding a rod of steel one-third less diameter, fixed firmly and truly in the slide rest tool holder, so as to just bear upon the descending side of the inner tube, as the former moves in and out, and is constantly supplied with plenty of water and fresh emery. Polish by wrapping a few thicknesses of alpaca or linen round the steel, and use finely washed rouge. This is the only way to get a perfectly true barrel.

Ground Glass.

Lainer recommends the following process in the *Chemiker Zeitung*: Mix 240 c. cm. of commercial hydrofluoric acid of 1.258 specific gravity with 600 grams of pulverized soda crystals, then dilute with 1,000 c. cm. of water. After standing for some time a sediment is formed, and over it a clear solution. The thoroughly cleaned glass pane is provided with a wax edge (prepared by kneading yellow wax with tallow, rosin and asphalt powder) and pre-etched with common hydrofluoric acid (1 : 10) for some minutes to obtain an absolutely clean glass surface. Then wash with water and wipe the plate with a clean, soft sponge until the surface is only slightly moist. Stir up the paste of the etching acid, and pour the mass ½ to 1 cm. high upon the pane. With this mixture a nice normal deadening is obtained after one hour. If the acid is old, having been used often, it may be made to act longer upon the plate of glass. The liquid is poured back into the vat, and the glass is rinsed off with water. Then the water is allowed to remain upon the pane until a skin, formed from the surface of the glass, can be removed with the finger or a brush. The strong deadening obtained by this method can be fixed to any desired degree of transparency by etching with hydrofluoric acid.

Lettering and Labeling. (See **Etching Glass** above.)

Gold Letters on Glass.—Those parts of the glass which are to be gilded are painted with a saturated solution of borax; upon the surface thus prepared gold-leaf is placed and pressed evenly and firmly by means of a piece of cotton. The glass is then gently and carefully heated over an alcohol lamp until the borax melts, after which it is allowed to cool. If the glass is to be decorated with gold letters or other designs the parts to which these latter are to be affixed are covered with a solution of sodium silicate, applied with a brush; the gold-leaf is placed upon this layer and pressed down evenly with a plug of cotton. The object is warmed at about 136° F., in order to effect a partial drying, and the figures are then traced upon the gold-leaf by means of a lead pencil, the edges of the leaf trimmed off, and the object is dried by heating to a higher temperature.

Signs.—The words should be set up in the desired style and size of type, and several impressions made on transparent paper. One of the impressions should be placed with its back to the glass and lightly attached to it at the edges. From the other sheets the letters should be separately and neatly cut, and stuck on the glass with the printed surface in contact with it. The paste used for this purpose may be mixed with color resembling that of the printing. The lettering showing through to the other side gives the right position for the lettering to be applied. Air bubbles must be well rubbed out, or, if necessary, pricked open with a needle. When the letters pasted on are dry, all the paste adhering to the polished glass is removed with the aid of a clean cloth. To secure the letters, zinc white is rubbed down with thin linseed-oil varnish to make a paint with which the surface, including the back of the letters, must be painted over. When everything is dry the center sheet is removed, and the lettering appears in black, red, blue, or parti-colors, on a gray background.

Matt.

1.—Make a thick paste of powdered fluorspar, place in a leaden dish, lay the glass to be etched over the dish, and apply gentle heat. This will give extremely fine matting. It should be done outdoors, or in a fume closet.

2.—Dissolve gelatine, 20 gr.; sodium fluoride, 20 gr.; in warm water, 1 oz. Pour over glass, allow to set while level, and leave to dry. Immerse in hydrochloric acid, ½ oz., water, 8 oz., for 30 seconds, then dry.

3.—J. B. Miller contributes to *Neuste Erfindung* a description of a rapid and practical method of printing designs or labels on glass. The ink employed consists of French oil of turpentine, 90 parts; Burgundy pitch, 30 parts; pulverized Syrian asphalt, 10 parts; pulverized mastic, 2 parts. These are boiled together, and form a pasty varnish, which is spread out on a plate of ground glass, from which it is transferred to the rubber tire by means of a rubber roller. The ink must not be put on too thick. The glass is printed with this ink, and then dusted over with finely pulverized Syrian asphalt and heated in a sheet-iron muffle until the ink and asphalt unite to form a brilliant varnish. If the glass is to be deeply etched the dusting with asphalt must be repeated. If the whole glass is not to be rendered matt, the remainder is covered, with the exception of a round or oval vignette, with a mixture of stearine, 1 part; and tallow, 2 or 3 parts. It is then put in lye, and the part that is to be etched is well washed with water, when the glass is put in dilute hydrofluoric acid for 5 minutes, rinsed with water, and put in the matt bath, where it is left 15 or 20 minutes. It is afterward cleansed with hot lye and polished.

Mirrors. (See **Silvering.**)

Opaque, To Render Glass.

1.—The following method renders window glass non-transparent, while permitting light to pass through. Paint or pencil the glass with the following solution: Zinc sulphate, 3 parts; magnesium sulphate, 3 parts; dextrine, 2 parts; water, 20 parts. Mix. On drying, the mixture of salts crystallizes in fine needles, which prevents vision through the glass.

2.—The following, if neatly done, renders the glass obscure yet diaphanous: Rub up, as for oil colors, a sufficient quantity of sugar of lead with a little boiled linseed oil, and distribute this uniformly over the pane from the end of a hog-haired tool, by a dabbing, jerking motion, until the appearance of ground glass is obtained. It may be ornamented, when perfectly hard, by delineating the pattern with a strong solution of caustic potash, giving it such time to act as experience dictates, and then expeditiously wiping out the portion it is necessary to remove.

3.—For this purpose, German bronze factories manufacture a special silver-bronze, with a matt glass luster. Any desired design or pattern can be applied on the glass—*e.g.*, glass doors, which look like etched glass, and constitute a pretty decorative effect.

4.—Panes may also be rendered matt and non-transparent by painting them on one side with a liquid prepared by grinding whiting with potash water-glass solution. After one or two applications the panes are perfectly opaque, while the room remains as light as before.

Painting on Glass.

Clear rosin, 1 oz.; melt in an iron vessel; let cool a little, but not harden; then add oil of turpentine sufficient to keep it in a liquid state. When cold, use it with colors ground in oil.

Platinum Deposits on Glass.

The following method of depositing brilliant films of platinum on glass was devised by Professor Bottger. In order to succeed in coating porcelain or glass with a perfectly faultless film of platinum, of the brilliancy of silver, it is indispensably requisite to make use of perfectly dry platinum chloride, which must be as free from acid as possible. To that end, pour some oil of rosemary over the perfectly dry platinum chloride, in a small porcelain mortar, and knead it up with the paste, renewing the oil about three times, and continue this operation until at length there is produced from the brownish-red chloride a soft plaster-like mass, the color of which is as black as pitch, and wherein no particles of undecomposed platinum chloride are discoverable. The oil of rosemary assumes hereby a more or less yellow color, in consequence of its partially taking up chlorine from the platinum chloride. When at length we have arrived at converting the whole of the platinum chloride into the black plaster-looking mass spoken of, rub it well up with the pestle, after pouring the oil of rosemary off, with about five times its weight of oil of lavender, and continue to do so until it has become a perfectly homogeneous thin fluid. It must then be left to stand for ½ hour or so, for it is not until after that interval that it can be used with advantage for platinizing. For the production of the brilliant platinum film, all that is now required is to apply the mass as uniformly as may be, and in the thinnest possible coat, to the objects of porcelain, earthenware or glass, by means of a soft, delicate brush. The thinner the coat of the above described preparation the more brilliant the film of platinum subsequently proves. When the articles have been gone over as thinly as possible with the fluid, conformably with these instructions, all that is required further is to subject them for a few minutes to a very low, scarcely perceptible red heat, either in a muffle, or in the flame of a Bunsen gas blowpipe, used with caution. The articles receive from this baking (supposing always that the temperature described has not been exceeded), without requiring any subsequent treatment, an incomparably beautiful luster, as brilliant as silver. If, by any oversight, the coating of platinum upon the articles has turned out faulty, or in the case of breakage occuring during the baking, every trace of the metal may be recovered with facility, from the objects that have suffered, by means of the following very simple galvanic process, without being obliged to have recourse to the use of aqua regia. Nothing more is required than to pour common hydrochloric acid over them, and then touch them with a zinc rod. On doing this, as quick as lightning, in consequence of the hydrogen evolved both at the upper and lower surface of the film of platinum which acts as the negative pole, we see the shining metallic coating peel off in the form of infinitely thin leaves, from the base of porcelain or glass, and, notwithstanding the specific gravity of the metal, ascend partially, and float on the surface of the acid. On separating the hydrochloric acid by the use of a filter, the whole of the platinum, which would be otherwise lost, is recovered, so that no complaint arises as to the waste of any of the metal in question. Prepare at once only as much of the platinzing fluid as is required for the day's use, inasmuch as it loses in efficiency by keeping. That which forms the active principle in the fluid, which results from treating platinum chloride with oil of lavender, as above described, is an organic platinum salt, which, in point of fact, one can obtain, after some time, in the form of small elongated octahedral crystals, of a pale yellowish color, by washing out carefully with alcohol a tolerable quantity of the fluid. The crystals have the property of taking fire with a brilliant flame on being brought near a lighted candle, leaving a residue of compact platinum of dazzling whiteness.

Powdering.

Powdered glass is frequently used instead of paper, cloth, cotton or sand for filtering varnishes, acids, etc. It is not soluble or corrodible. Sand, if purely silicious, would be better, but such sand is difficult to get; it too often contains matters which are easily corroded or dissolved. Powdered glass, when glued to paper, is also used for polishing wood and other materials. It cuts rapidly and cleanly, and is better than sand for most purposes. Glass is easily pulverized after being heated red hot and plunged into cold water. It cracks in every direction, becomes hard and brittle, and breaks with keenly cutting edges. After being pounded in a mortar it may be divided into powders of different degrees of fineness by being sifted through lawn sieves.

Silvering Glass.

1.—Ordinary water must never be used in silvering; it must always be distiled water. (a) Reducing Solution: In 12 oz. of water dissolve 12 gr. of Rochelle salts, and boil; while boiling, add 16 gr. of nitrate of silver dissolved in 1 oz. of water, and continue the boiling for 10 minutes more; then add water to make 12 oz. (b) Silvering solution: Dissolve 1 oz. of nitrate of silver in 10 oz. of water, then add liquid ammonia until the brown precipitate is nearly, but not quite, all dissolved; then add 1 oz. of alcohol, and sufficient water to make 12 oz. To silver: Take equal parts of (a) and (b), mix thoroughly, and lay the glass, face down, on top of the mixture while wet, after it has been carefully cleaned with soda and well rinsed with clean water. Distilled water should be used for making the solutions. About 2 dr. of each will silver a plate 2 in. square. The dish in which the silvering is done should be only a little larger than the paltè. The solution should stand and settle for 2 or 3 days before being used, and will keep good a long time.

2.—(a) Nitrate of silver, 1 oz.; water, 10 oz. (b) Caustic potash, 1 oz.; water, 10 oz. (c) Glucose, ½ oz.; water, 10 oz. The above quantities are those estimated for 250 sq. in. of surface; add ammonia to solution (a) till the turbidity first produced is just cleared; now add (b), and again ammonia to clear; then a little solution, drop by drop, till the appearance is decidedly turbid again; then add (c), and apply to the clean glass surface. A film was obtained in 43 minutes at a temperature of 56° F.

3.—First take 80 gr. of nitrate of silver (either lunar caustic or the crystallized salt), and dissolve it in 10 oz. of water, preferably distilled or rain water. To this add 2 oz. of alcohol and 2 oz. of aqua ammonia. The ammonia is added to the solution, drop by drop, until the precipitate at first formed is dissolved. The solution is then allowed to settle for 3 or 4 hours, when it is ready for use, and forms solution No. 1. Then take 6 oz. of water and dissolve it in 24 grams of nitrate of silver, and add to the same 30 grams of arsenite or tartrate of copper, and then add, drop by drop, sufficient aqua ammonia to dissolve the precipitate of oxide of silver at first formed, and the arsenite or tartrate of copper, after which add 2 oz. of alcohol. Then make a separate solution of 48 grams of potassa in 16 oz. of water. This last mentioned solution is brought to a boiling temperature in an evaporating dish, after which the solution of nitrate of silver and arsenite or tartrate of copper is added, drop by drop, to the boiling solution of potassa, and the boiling is continued for about an hour, or until a white film collects on the surface, after which it is allowed to cool and filter, when it is ready for use, and forms solution No. 2. In deposting the alloy upon the glass, take a suitable quantity of filtered water, preferably rain or distilled water, and add to it equal parts of solutions Nos. 1 and 2, and mix the whole thoroughly, and apply this solution in any convenient manner to the glass to be coated, and the deposition imediately commences, and is allowed to continue, say, for about 10 minutes, until the metal in solution is entirely exhausted, when the glass will be covered with a coating of the alloy, having a brilliant reflecting surface adjoining the glass. In order to increase the durability of the coating it is preferable to deposit a second coating upon the first, which is done by repeating the operation before the first coating is dry, and after the coating is completed, generally cover the whole with a heavy coat of asphaltum varnish, although this is not absolutely necessary, as the metallic alloy is sufficiently hard to stand ordinary wear without it. By the above described process an alloy having all the qualities of hardness and durability of the ordinary alloys of copper and silver is deposited upon the glass, and the degree of hardness may be varied or modified by varying the proportions of the different ingredients employed. Other salts of copper besides the arsenite or tartarate may be employed in conjunction with the nitrate of silver.

4.—Silvering solution: Dissolve 48 gr. of silver nitrate in 1 oz. of distilled water, and to the solution add ammonia water until the precipitate at first thrown down by it is nearly, but not quite, redissolved Let stand for an hour or two, then filter, and to the filtrate add sufficient distilled water to make 12 fl.oz. Reducing solution: In a flask of sufficient capacity dissolve 12 gr. of sodium and potassium tartrate (Rochelle salt) in 1 oz. of distilled water. Bring to a boil, and while boiling add 2 gr of silver nitrate dissolved in 1 dr. of distilled water. Let boil for 3 or 4 minutes, then remove from the fire; let cool down, and after letting stand a few minutes filter through paper. To the filterate add sufficient distilled water to make, as before, 12 fl oz. To use: Make the glass to be silvered *chemically clean* on the side on which the silver is to be deposited To effect this, cleanse first with sulphuric or nitric acid, rinse in running water, and then flood with liquor potassae. If necessary, to get rid of grease, repeat these processes, rinse in running water, and finally in alcohol. Be careful not to let your fingers come in contact with the surface after cleansing, but handle the plate either with clean wooden forceps or in such manner that nothing comes in contact with the cleaned surface. To silver, equal parts of the fluids are necessary. As the deposition of the metal goes on from every direction at once, but is strongest and best at the top, smaller mirrors are silvered by suspending the glass, cleaned surface downward, over a vessel having the same superficial area as the glass, set perfectly level, and filled with the mixed liquid. The surface of the glass should exactly touch that of the liquid at all points, and care should be taken that no bubbles or air spaces are left between the surfaces. In warm weather, all that is necessary is to place the vessel and glass where the direct sunlight (or a strong diffused light) can reach it; but in cold weather the apparatus should be kept at a temperature of from 90 to 110° F. The liquid at first becomes intensely black, but clears up as the reduction progresses. As soon as it becomes somewhat clear the process should be stopped, the glass removed and rinsed under running water, and allowed to dry spontaneously. The silvered surface should subsequently be varnished with a strong solution of shellac into which some thickennig powder (such as English red) has been stirred. While the silvering and reducing liquids are the same, larger mirrors are treated very differently.

5—Dissolve 120 gr of silver nitrate in 2 oz. of distilled water, and pour this solution quickly into a boiling solution of 96 gr. of Rochelle salt in about 2 oz. of water. When cool, filter, and make up to 24 fl oz. with distilled water. Now make a separate solution of 120 gr. of silver nitrate in 2 oz of distilled water, and add ammonia until the precipitate is nearly redissolved Make up to 24 fl.oz. with distilled water. For use, mix equal quantities of these two solutions just before the silvering is to be done.

6—Dissolve 96 gr. of silver nitrate in 2 oz. of distilled water, and add ammonia until the precipitate is nearly dissolved; filter, and make up to 24 fl.dr. with distilled water. Now make a separate solution of 24 gr. of Rochelle salt in 2 oz. of distilled water: boil this, and while boiling add 4 gr. of nitrate of silver, previously dissolved in 2 dr. of water. When cool, filter, and make up to 24 fl.dr. For use, mix equal quantities of the two solutions just before the silvering is to be done.

7.—Pure silver nitrate, 10 gr. to 1 oz. of distilled water; add carefully, drop by drop, strong ammonia, until the brown precipitate is redissolved. When adding the ammonia keep stirring with a glass rod. In another bottle make a solution of 10 gr. of pure crystallized Rochellee salt to 1 oz. of distilled water; then, when you haves all ready, pour on sufficient to cover all the glass, using two-thirds of the silver solution and one-third of the Rochelle salt. The mirror can be prepared well by cleansing it with a little wet rouge and polishing dry with a wash-leather; then warm the glass before the fire, or by letting it lie in the sun, to about 70 to 80° F. Pour on the solution as described above, and let it stand in the warm sunshine ½ to 1 hour. When silvered, pour on it some clean soft or distilled water, and while still wet wipe it very gently all over with a little soft wadding, wet; this will take off all the roughness, so that it will take but little rubbing with the rouge leather to polish it. When perfectly dry it is easily rubbed up to an exquisite polish.

8.—Place a sheet of glass, previously washed clean with water, on a table, and rub the whole surface with a rubber of cotton, wetted with distilled water, and afterward with a solution of Rochelle salt in distilled water, 1 part of salt to 200 parts of water. Then take a solution, previously prepared by adding silver nitrate to ammonia of commerce, the silver being gradually added until a brown precipitate commences to be produced; the solution is then filtered. For each square yard of glass take as much of the above solution as contains 20 grams (about 309 gr.) of silver, and to this add as much of a solution of Rochelle salt as contains 14 grams of salt, and the strength of the latter solution should be so adjusted to that of the silver solution that the total weight of the mixture above mentioned may be 60 grams. In a minute or two after the mixture is made it becomes turbid, and it is then immediately to be poured over the surface of the glass, which has previously been placed on a perfectly horizontal table, but the plate is blocked up at one end to give it an inclination about 1 in 40; the liquid is then poured on in such a manner as to distribute it over the whole surface without allowing it to escape at the edges When this is effected the plate is placed in a horizontal position at a temperature of about 68° F. The silver will begin to appear in about 2 minutes, and in 20 to 30 minutes sufficient silver will be deposited. The mixture is then poured off the plate, and the silver it contains is afterward recovered. The surface is then washed four or five times, and the plate is set up to dry. When dry, the plate is varnished by pouring over it a varnish composed of gum dammar, 20 parts; asphalt or bitumen, 5 parts; gutta percha, 5 parts; benzine, 75 parts. The varnish will set hard on the glass, and the plate is then ready for use.

9.—The following is a successful method for the inexperienced, and produces a fixed, hard film of good density. Get three open glass jars or tumblers, and chemically cleanse them with nitric acid. Dissolve 180 grains of nitrate of silver in 3 oz. of distilled water in one of the tumblers. (When dissolved, take ½ oz. of this solution and put it aside in another jar or bottle, this also being chemically clean.) In another of the tumblers dissolve 150 grains of caustic potash (pure by alcohol) in 2½ oz. of distilled water. In the third tumbler dissolve 75 grains of chemically pure glucose in 2½ oz. of water. Now take the first tumbler with the silver solution in it and drop some pure ammonia into it until the solution becomes a muddy-brown color. Continue dropping the ammonia until the solution becomes clear again and looks as it was before the ammonia was added. Now take the separate ½ oz. of silver solution and drop some of this in the ammoniated solution, drop by drop, the same as the ammonia was added. This will make the solution muddy again—more yellow than brown. Use care with the silver solution, as any spilled on the hands will remove the skin. Now add the potash solution, and the mixture will go blackish. After this continue dropping ammonia in, stirring with a glass rod all the time, until the solution begins to clear again. It will not get as clear as before, as there will be numberless black particles. Filter the solution by pouring it through a funnel in which is a plug of cotton wool or a filter paper. Now add more of the spare silver solution, drop by drop, stirring all the time, until a very faint precipitate again occurs, then immediately stop dropping the solution. Prepare the silvering dish, set it level, and pour the solution in; add sufficient distilled water to make it the right height in the dish. Pour the glucose solution in, and stir together. Immerse the surface of the mirror glass gently, holding it slanting as it is lowered in, so that air bubbles will not be held under. By the time the glass is in position the solution will be a pale reddish-purple color, and will grow darker. A fine deposit of silver will soon come, and will be complete in from 10 to 20 minutes. Will wash the mirrow with water, and place on edge to dry. The film can be polished with fine wash-leather over a pad of cotton wool for about 15 minutes. The polishing must be gently done.

10.—Brashear's Process.—The most important thing is the sugar solution forming the reducing agent. This greatly improves by keeping—a solution that has been made some months being much more effective than a newly-made one. It is convenient to have always some Winchester quarts of it in stock for use. For convenience his proportions may be varied slightly, and are thus given: For the sugar solution add to 10% of loaf sugar, in distilled water, 10% of alcohol and ½% of nitric acid. Solutions of 10% of silver nitrate and of caustic potash are separately prepared, the latter one as wanted. These, with sufficient ammonia, and a very dilute solution of silver nitrate, and also a similar very dilute one of ammonia, are prepared, the latter in order to obtain that pale brown color of the ammoniated solution of silver nitrate that is absolutely necessary to have before adding the reducing agent. Having selected a suitable dish to contain the liquid, in which the mirror can be placed face downward, with about ½ to ¾ in. of liquid

CAUTION.—Always add ammonia slowly and protect the eyes with goggles as explositions occasionally occur even in the hands of expert chemists.

underneath, find, on the basis of 1 part of silver-nitrate solution to 4 parts of the total required liquid, the amount of silver solution needed: to this add ammonia till the first formed precipitate is dissolved, then add half this quantity of the potash solution (this is a variation from Mr. Brashear's formula that has been found to work well), and again add ammonia till the mixed solution is quite clear, taking care to put in only sufficient ammonia for that purpose; then add the weak solution of silver nitrate till a clear brown color is obtained; should this become a dark brown, some of the weak solution will bring it to a pale brown color, which must persist if the solution is left standing some time. The mirror, previously cleaned with nitric acid and distilled water, and suspended in the dish in distilled water of sufficient amount to make up, on addition of the solutions, the total liquid required, is lifted out, and the prepared solutions are mixed with the distilled water and an amount of the reducing solution equal to about one-half that of the silver-nitrate solution, more or less, as the temperature is under of above 60°; as soon as all is intimately mixed the mirror is immersed with one movement, beginning by dipping the edge first, and lowering so as to prevent any air bubbles forming under the glass. In 3 to 5 minutes the silver begins to form on the mirror, the solution changing from pink to dark brown or black; the film thickens quickly, and in 25 to 30 minutes sufficient silver is deposited. The mirror can then be washed and put to soak in distilled water for a few hours, then taken out, and dried and polished in the usual way; that is, with a soft pad of clean chamois, and going all over the mirror with light strokes till the bloom is all removed and a fair polish is obtained, finishing with a very little of the finest washed rouge, quite dry, lightly dusted on the pad. It is very important to well consolidate the film of silver by the unrouged pad before using any polishing powder. It is a very good plan for any one who is not in the habit of silvering, or to whom the process is trange, to try the proportion of the solutions on some small pieces of glass till a satisfactory proportion for the temperature (for that is the chief factor in varying the amount of reducing solution necessary) of the room in which he is working. The most important thing (after the solutions) is the proper cleansing of the glass, for on the proper preparation of the surface of the glass a very great deal depends. As already stated, this process is used when the glass to be silvered can be suspended in the liquid; it is not suitable when we attempt to silver surfaces face upward. The mud formed settles down, and prevents any proper deposition of silver: this was a source of considerable trouble when it was required to silver a 3-ft. mirror, and a pneumatic arrangement was eventually made to hold the mirror by the back, so that it could be silvered face downward, and up to that size the silvering could be managed.

11.—Barton's Process.—(a) Nitrate of silver, 25 gr.; distilled water, 1 oz. (b) Pure potash, 25 gr.; distilled water, 1 oz. (c) Solution A, 1 part; solution B, 1 part. Ammonia to just dissolve the precipitate; solution A to just cause a discoloration. (d) Loaf sugar, 2,700 gr.; distiller water, 20 oz.; nitric acid, 2 dr.; strong alcohol, 10 oz.; distilled water, to make 80 oz. For use: Solution (c), 1 oz.; solution (d), 1 dr. Solution (c) is subject to slow decomposition; solution (d), on the contrary, improves by keeping.

12.—Draper's Method.—Dissolve 500 gr. of Rochelle salts in 3 oz. of water; dissolve 800 gr. of nitrate of silver in 3 oz. of water; add silver solution to 1 oz. of strong ammonia until brown oxide of silver remains undissolved, then add alternately, ammonia and silver solution carefully until the nitrate of silver is exhausted, when a little of the brown precipitate should remain; filter. Just before using, mix with the Rochelle salt solution, and dilute to 22 oz. Clean the mirror with nitric acid or plain collodion and tissue paper. Coat a tin pan with beeswax and rosin, equal parts. Fasten a stick, ¾ in, thick, across the bottom. Pour in the silvering solution. Put in quickly the glass mirror, face downward, one edge first. Carry the pan to the window and rock the glass slowly for ½ hour. Bright objects should now be scarcely visible through the film. Take out the mirror; set it on edge on blotting paper to dry. When thoroughly dry, lay it, face up, on a dusted table; stuff a piece of soften thin buckskin loosely with cotton, and go gently over the whole silver surface with this rubber, in circular strokes. Put some very fine rouge on a piece of buckskin, laid flat on the table, and impregnated the rubber with it. The best stroke for polishing is a motion in small circles, at times going gradually around on the mirror, at times across, or the various chords. At the end of an hour of continuous gentle rubbing, with occasional touches on the flat, rouged skin, the surface will be polished so as to be perfectly black in opaque positions, and, with moderate care, scratchless. It is best, before silvering ,to warm the bottle of silver solution and the mirror in water heated to 100° F.

13.—Drayton's Process.—(This may be considered as the earliest of the nitrate of silver methods.) A mixture is made of 1 oz. of coarsely pulverized silver nitrate, ½ oz. of spirits of hartshorn and 2 oz. of water, which, after standing for 24 hours, is filtered, the deposit upon the filter, which is silver, being preserved, and an addition is made thereto of 3 oz. of spirits of wine; at 60° above proof, or naphtha; 20 to 30 drops of oil of cassia are then added; and after remaining for about 6 hours longer the solution is ready for use. The glass to be silvered with this solution must have a clean and polished surface; it is to be placed in a horizontal position, and a wall of putty or other suitable material is formed around it, so that the solution may cover the surface of the glass to the depth of ⅛ to ¼ in. After the solution has been poured on the glass, 6 to 12 drops of a mixture of oil of cloves and spirits of wine, in the proportion of 1 part, by measure, of oil of cloves to 3 parts of spirits of wine, are dropped into it at different places; or the diluted oil of cloves may be mixed with the solution before it is poured upon the glass; the more oil of cloves used the more rapid will be the deposition of the silver, but the operation should occupy about 2 hours. When the required deposit has been obtained the solution is poured off, and as soon as the silver on the glass is perfectly dry it is varnished with a composition formed by melting together equal quantities of beeswax and tallow. The solution, after being poured off, is allowed to stand for 3 to 4 days in a close vessel, as it still contains silver, and may be again employed, after filtration and the addition of a sufficient quantity of fresh ingredients to supply the place of these which have been used. About 18 gr. of silver nitrate are use for each square foot of glass, but the quantity of spirit varies somewhat, as its evaporation depends upon the temperature of the atmosphere and the duration of the process. By the addition of a small quantity of oil of carraway or thyme, the color of the silver may be varied. The oil of cassia purchased of different manufacturers varies in quality; therefore, on being mixed with the solution, it must be filtered previous to use.

14.—Martin's Method.—(a) Nitrate of silver, 175 av.gr.; distilled water, 10 av.oz. (b) Nitrate of ammonia, 262 av.gr.; distilled water, 10 av.oz. (c) Pure caustic potash, 1 av.oz.; distilled water, 10 av.oz. (d) Pure sugar candy, ½ av.oz.; distilled water, 5 av.oz. Dissolve, and add tartaric acid, 50 av.gr. Boil in a flask for 10 minutes, and, when cool, add alcohol, 1 av.oz.; distilled water, q. s. to make up to 10 oz. For use, take equal part of (a) and (b); mix together also equal parts of (c) and (d), and mix in another measure. Then mix both these mixtures together in the silvering vessel, and suspend the mirror face downward in the solution.

15. — Palmieri's Process. — Professor Palmieri has devised a process for silvering glass by means of a reducing action on the salts of silver, which is said to have the advantage of producing a very brilliant metallic deposit. When into an ammoniacal solution of silver nitrate is poured, first a little caustic potash, and then a few drops of glycerine, the reduction begins at once; and this action is accelerated if ether or alcohol be added to the mixture. A moderate heat and darkness are said to increase the brilliancy of the precipitate, and darkness also favors the adhesion of the deposit to the mirror.

Solution 1. Silver nitrate, 1 oz.; water, 10 oz. Solution 2. Caustic potash, 1 oz.; water, 10 oz. Solution 3. Glucose, ½ oz.; water, 10 oz.

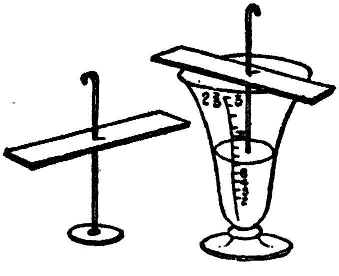
The above quantities are those estimated for 250 sq. in. of surface. Add ammonia to solution No. 1 till the turbidity first produced is just cleared. Now add No. 2 solution, and again ammonia to clear; then a little solution, drop by drop, till the appearance is decidedly turbid again. Then add No. 3 solution, and apply to the clean glass surface. A film was obtained in 43 minutes at a temperature of 56° F. The plate of glass was rather large: 37 in. diameter and 4½ in. thick, and weighed 4 cwt.

Silvering Solution.—In 1 oz. distilled or pure rain water, dissolve 48 gr. crystallized silver nitrate. Precipitate by adding strongest water of ammonia, and continue to add the ammonia, drop by drop, stirring the solution with a glass rod, until the brown precipitate is nearly, but not quite, redissolved. Filter, and add distilled water to make 12 fl. dr.

Reducing Solution—Dissolve in 1 oz. distilled or very clean rain water, 12 gr.

potassium and sodium tartrate (Rochelle or Seignette salts). Boil in a flask, and while boiling add 2 gr. crystallized silver nitrate dissolved in 1 dr. water. Continue the boiling 5 to 6 minutes. Let cool, filter, and add distilled water to make 12 fl. dr.

To Silver.—For a mirror 1¼ to 1½ in. diameter, take an ordinary 2 oz. graduated glass; procure a piece of thin wood (cigar box will do) long enough to go across the top of it, and through the center of the wood thrust, as shown here, a wire 7 to 8 in. long. After cleansing the glass to be silvered by immersing it in strong nitric acid, washing in liquor potassae, and throughly rinsing with distilled water, with a bit of sealing wax attach one end of the wire to its face, as in the cut. If the glass has had mercuria amalgam on it, it will probably be necessary to clean the back with rouge. On having this surface perfectly chemically clean, depends in a great measure the success of the operation.



Silvering Devices

Having attached the glass to the wire, lay the strip across the graduate, move the glass disc downwards until it nearly, but not quite, touches the side of the graduate all round, taking care that its edges shall be as nearly level as possible. Having ascertained the height in the graduate at which the disc should stand, bend or clamp the wire so that it cannot slip. In the ordinary graduate, with a mirror 1⅜ in. diameter, this will be at the 6 dr. mark, as nearly as may be. Remove the glass and pour into the graduate enough of equal quantities of the two solutions to fill the graduate exactly to the previously ascertained level. Stir the solutions so that they will become thoroughly mixed, and replace the disc to be silvered, taking great care that the surface to be silvered shall come in contact with the silvering fluid exactly at all points. The disc should be rinsed carefully before replacing, and should be put in while wet. Great care should be taken that no air-bubbles remain on the surface of the solution, or between it and the surface to be silvered.

Now set the graduate in the sun for a few minutes, if the weather be warm, or by the fire, if it be cold, as a temperature of 113 to 122° F. is not conducive to the rapid deposition of a brilliant, firm, and even film of silver. The fluid in the sunlight soon becomes inky black, gradually clearing as the silver is reduced, until when exhausted it is perfectly clear. The mirror should be removed before this point is reached, as a process of bleaching sets up if left after the fluid is exhausted. From 20 to 80 minutes, according to the weather, purity of chemicals, etc., is required for the entire process.

When the mirror is removed from the bath, it should be carefully rinsed with distilled water from the wash bottle, and laid on its edge on blotting paper to dry. When perfectly dry, the back should be varnished with some elastic varnish and allowed to dry. The wire and sealing wax can now be removed from the fact, and the glass cleaned with a little pledget of cotton and a minute drop of nitric acid, taking great care that the acid does not get to the edges or under the varnish. Rinse, dry, and the mirror is finished. The light reflected from a mirror made thus has somewhat of a yellowish tinge, but photometric experiments show that 25 to 30% more light is reflected than from the old mercurial mirrors.

Balls.—Lead and tin, of each 2 oz.; bismuth, 2 oz.; mercury, 4 oz. Melt together in order given. Have the globe perfectly clean and dry. Warm it, melt the amalgam and pour it in and roll it about until the glass is coated. To high a heat in use will spoil them.

Amalgams for Silvering Glass Globes.—

Lead.	Tin.	Bismuth.	Mercury.
1	1	1	1
1	1	1	2

The lead and tin are melted first, after which the bismuth is added. The dross is scraped off and the mercury added, when the whole mixture is well stirred. Leaves of Dutch metal are sometimes added, according to the color which it is desired to impart to the globes.

Curved Glass.—This is a French process, used not only for flat surfaces, but also for those which are curved, or cut into patterns. Dissolve 600 gr. neutral silver nitrate in 1,200 gr. distilled water, add 75 drops of a solution composed of 25 parts distilled water, 10 ammonia sesquicarbonate, and 10 ammonia, sp. gr. 0.980; add also 30 gr. ammonia, same sp. gr., and also 1,800 gr. alcohol, sp. gr. 0.85. When clear, the liquor is decanted or filtered, and mixture of equal parts alcohol and oil of cassia is added to the silver solution in the proportion of 1 of the oil of cassia to 15 of the silver solution, the mixture is agitated and left to settle, then filtered. Before pouring upon the glass surface, or into the glass vessel to be silvered, the solution is mixed with 1-78th its bulk of essence of cloves, 1 part oil of cloves, 3 parts alcohol. The glass is thoroughly cleaned, and the silver solution is applied and warmed to 100° F. for about 3 hours; the liquid is poured off, and the silver deposit is washed, dried and varnished.

Globes.—1.—Nitrate of silver, 1 oz.; distilled water 3 oz.; alcohol, 3 oz.; ammonia, sufficient, or about 1 oz.; grape sugar, 2 oz.

Dissolve the nitrate of silver in the water, add ammonia in a quantity just sufficeint to redissolve the precipitate formed at first, add the alcohol, allow it to rest four or five hours and filter. The grape sugar is dissolved separately in 1 oz. of water, and added to the silver solution to the moment of using. The glass globes being perfectly cleaned, the solution is poured into them, and the globes are turned on all sides in front of a moderate fire, so that the liquid touches every part alike. The coating is done in a few minutes, when the excess liquid is to be removed and the globe washed with distilled water first, and lastly with alcohol. The success of the operation depends in a great degree on the cleanness of the surface of the glass to be silvered; the slightest speck of dust or grease spot is sure to show. A good way to clean the globes would be to wash them with a warm solution of soda, then with dilute nitric acid, and lastly with alcohol, care being taken not to touch with the fingers any part of the globes which is intended to be silvered.

2.—Take 1-3 ounce of clean lead, and melt it with an equal weight of pure tin; then immediately add ½ oz. of bismuth, and carefully skim off the dross; remove the alloy from the fire, and before it grows cold add 5 oz. of mercury, and stir the whole well together; then put the fluid amalgam into a clean glass, and it is fit for use. When this amalgam is used for silvering, let it be first strained through a linen rag; then gently pour some ounces thereof into the globe intended to be silvered; the alloy should be poured into the globe by means of a paper or glass funnel reaching almost to the bottom of the globe, to prevent it splashing the sides; the globe should be turned every way very slowly, to fasten the silvering.

3.—Make an alloy of 3 oz. of lead, 2 oz. of tin, and 5 oz. of bismuth; put a portion of this alloy into the globe, and expose it to a gentle heat until the compound is melted; it melts at 197° F.; then by turning the globe slowly round an equal coating may be laid on, which, when cold, hardens and firmly adheres. This is one of the cheapest and most durable methods of silvering glass gloves internally.

4.—Nitrate of silver, 1 oz.; distilled water, 1 pint; string liquid ammonia, sufficient quantity, added very gradually, to first precipitate and then redissolve the silver; then add honey, ¼ oz. Put sufficient quantity of this solution in the globe, and then place the globe in a saucepan of water; boil it for 10 to 30 minutes, occasionally removing it to see the effect.

5.—a.—Nitrate of silver, 10 parts ;distilled water, 100 parts.

b.—Water of ammonia, specific gravity, 0.984.

c.—Solution of soda, 30 parts; distilled water, 500 parts.

d.—Cane sugar, 25 parts; distilled water, 200 parts: nitric acid, 1 part. Boil the three together for 20 minutes; when cool, add 50 parts of 90% alcohol and sufficient water to make 500 parts.

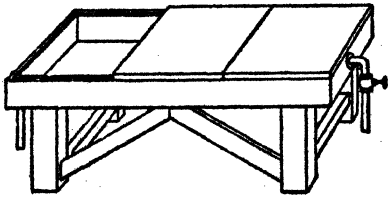
To silver a globe, mix 1½ oz. of sloution a, 1 oz. of solution b, 2½ oz. of c, and dilute with water to make 3 1-3 fluid oz.; allow it to stand 24 hours. For a globe of 1 quart, take 1 oz. of the above mixture, add 1 drachm of solution d, and shake it around in the bottle in the direct sunlight for 20 minutes.

Repairing a Damaged Mirror.—1.—Place the mirror face downward on a table and with a bit of cotton clean off the spot to be silvered, by rubbing it with a pledget of cotton. Now spread over the spot a piece of tinfoil a little larger than the area to be repaired, and after spreading out smoothly let fall on the center of it a drop of metallic mercury, and with a bit of chamois rub the foil until it becomes brilliant. Now place over the new amalgam a sheet of smooth writing paper and on it pile books or weights of any sort, and leave it overnight. The amount of weight needed is not great—just sufficient to keep the new amalgam in close contact with the glass. The amount of mercury needed should correspond as nearly as possible to 3 drachms to the square foot of surface to be resilvered. We may say, in conclusion, that while the above reads "easy," the job itself requires considerable practice to do it neatly and with dispatch.

2.—If mirrors coated become damaged they may sometimes be successfully repaired as follows:

Clean the bare portion of the glass by rubbing it gently with fine cotton, taking care to remove any trace of dust and grit. If this cleaning be not done very carefully, defects will appear around the place repaired. With the point of a penknife cut upon the back of another looking-glass around a portion of the silvering of the required form, but a little larger. Upon it place a small drop of mercury; a drop the size of a pin's head will be sufficient for a surface equal to the size of the nail. The mercury spreads immediately, penetrates the amalgam to where it was cut off with the knife, and the required piece may now be lifted and removed to the place to be repaired. This is the most difficult part of the operation. Then press lightly the renewed portion with cotton; it hardens almost immediately, and the glass presents the same appearance.

A Table for Plate-Glass Silvering.—The silvering of large mirrors or plate-glass is done on a moderately hot table, the hotter the table the quicker the silver will be deposited. The cut shows such a table. The body of the table may be described as a shallow zinc-lined trough or tank covered on top with slabs of slate. 1 in. board is used for the body of the table, 1½ in. slate for the top. The illustration shows a piece of slate removed. The slate is bedded on with red-lead and varnish to make it steam-tight. The slate top, when about to be used, has a blanket or felt cover, wetted with water before the heat is turned on. At one end of the body is the steam-pipe and valve, and the steam is turned on very gradually when first heating up. At the other end of the body is an outlet, and the steam-valve must be regulated so that while sufficient steam enters for the purpose very little is wasted by escaping from the outlet. This outlet also discharges condensed water and prevents steam pressure lifting the slates. The silvering process is to have the glass chemically clean and while still wet from the washing place it on the hot table, and at once pour over it a solution of gelatine or other mordant. Before this is dry cover the surface with the nitrate of silver solution and let it remain 10 minutes. Then wipe over with a leather squeegee and apply the silver solution again. Complete by wiping again with the squeegee.



Silvering Table

Varnish for Back of Silvered Mirrors.—Dammar gum, 20 parts; asphalt, 3 parts; gutta-percha, 5 parts; benzol, 75 parts. Mix and dissolve.

To use this varnish pour it over the silvered surface and move the plate back and forth until it is distributed evenly over the face.

Staining.

Use colors which come prepared especially for this purpose, as it hardly pays to prepare them, and the results are must more uniform. In general, the colors are rubbed upon glass with spirits of turpentine or lavender and applied to the glass, which has previously been sponged with gum water, to give it a slight tooth. Considerable skill and many attempts must be made before satisfactory work can be done. When the painting is finished each piece is fired in a muffle and is laid in a bed of sifted lime. Great skill is required in the firing and no general directions can be given. It is a much better plan to send the pieces to a man who makes a specialty of firing glass.

Stoppers.

Fitting.—1.—To fit a stopper to a bottle that has not been ground, use emery or coarse sand kept constantly wet with water, and replaced with fresh as fast as it is reduced to powder. When all the surface has become equally rough, it is considered a sign that the glass has been ground to the proper shape, as until that time the projecting parts only show traces of erosion. This is the longest and hardest part of the work, as after that the glass simply needs finishing and polishing. For that purpose emery only can be used, owing to the fact that the material can be obtained of any degree of fineness, in this respect differing from sand. Otherwise the operation is the same as before, the emery being always kept moistened, and replaced when worn out. The grinding is continued until both the neck of the bottle and the stopper acquire a uniform finish, of a moderate degree of smoothness, and until the stopper fits so accurately that no shake can be felt in it, even though it be not twisted in tightly.

2.—In stoppering a bottle, there are two processes: (a) The mouth of the bottle is opened to the required size by a steel cone revolving in a lathe: (b) the stopper is fixed in a wooden chuck, reduced to proper dimensions, and finally ground into the mouth of the bottle.

Removing.—1.—Place the bottle firmly on a table, and hold it with the left hand. Then apply the right hand to the stopper, and pull it forcibly on one side, using the thumb as a fulcrum at the exterior of the neck of the bottle. If the stopper moves, the motion will be indicated by a ticking kind of noise; and the stopper can then be withdrawn without further trouble. 2.—Tap the stopper on alternate side with the handle of a hammer, or with a piece of wood (not resting it on a hard substance, but holding the bottle in the hand or between the knees) it can frequently be loosened. 3.—Dip one end of a cloth in boiling water, and then wrap it round the neck of the bottle; the heat causes the neck to expand which allows the stopper more room, whereby it can often be removed with ease. 4.—The flame of a candle or small lamp may be applied to the neck of the bottle with the same effect. But in both cases the operation must be performed quickly, in order that the heat may not get at the stopper and expand it, for if such is the case, it remains as firmly fixed as before. 5.—Pass a piece of strong twine round the neck of the bottle and fix one end of the string to a hook; the neck will be heated by the friction occasioned by drawing the bottle rapidly backwards and forwards, the bottle being held in one hand, and the free end of the string in the other. The heat expands the neck as before described.

Substitute for Glass. (See also chapter on CELLULOID.)

1.—4 to 8 parts of gum cotton are dissolved in an adequate quantity of ether; this solution is mixed with 2 to 4% of castor oil, or any other non-resinifying oil, and from 4 to 10% of turpentine added to the mixture. The mixture is poured on to a glass slab and dried by a current of hot air, which, in a comparatively short period, transforms the fluid into a perfectly transparent, hard, amorphous plate, the thickness of which can be regulated as desired.

2.—*Tectorium.*—This material is prepared by applying a varnish to a finely-meshed iron-wire fabric. The varnish consists principally of good linseed oil, in which the vertically hanging wire fabric is repeatedly dipped up to as many as twelve times. After each dipping, the thin layer of oil is dried in warm air. The fabric thus obtained is exceedingly flexible, strong, impermeable, and very well adapted for skylights, greenhouses, etc.

Tuning Glasses.

(To play on with the palm of the hand.) The tones are dependent on the glasses and the amount of water used. Moisten the palm of the hand with water.

Writing on Glass.

a.—Ether, 500 gr.; sandarac, 30 gr.; mastic, 30 gr. Dissolve, then add benzine in small quantities till the varnish, spread on a piece of glass, gives it the aspect of roughened glass. The varnish is used cold. To have a homogeneous layer, pour over the already formed, some oil of petroleum, let it evaporate a little, then rub in all directions with cambric cloth till all is quite dry. With ink or lead pencil, lines can be produced on this surface as fine as may be desired. Thus a drawing may be prepared in a few minutes and immediately projected.

b.—The glass is to be first gently heated at a spirit lamp or gas flame, till steam ceases to be deposited on it, up to 112 or 140° F. (44 to 60° C.). Then a particular varnish should be poured upon it, as is done in photographic operation with collodion. This varnish is composed of 51 dwt. alcohol, 61 gr. mastic in drops, and 122 gr. pounce. The rosins are dissolved by being heated in a hot water bath, the whole being in a flask corked and fastened. The solution is afterward filtered. The varnish is very hard, and becomes brilliant and completely transparent. If it is poured on the cold glass, it becomes opaque and absorbs ink. Drawings may be executed upon it with common or India ink. Then a thin layer of gum is put upon it by dipping the glass in a very diluted solution of gum or any other non-alcoholic coating.

CHAPTER XII

HEAT TREATMENT OF METALS—ANNEALING, BRAZING, CASEHARDENING, HARDENING, TEMPERING AND WELDING

The distinction between "Hardening" and "Tempering" should be closely drawn. The word temper refers to the process of drawing temper after steel work has been hardened.

Oil tempering furnaces are designed to heat oil or tallow to about 600° F. and to control the temperature so as to draw and desired temper required in dies, cutters, punches, knives, shear blades, etc., which do not need to show the temper color.

Air tempering furnaces are used to draw, "spring temper" and for all work which must show a temper color.

Sand tempering machines are designed for special work to be drawn to any desired temper color, which must show on the surface, and especially for heavy pieces which cannot be heated quickly enough in hot air and require that they be kept in motion.

ANNEALING.

Brass or Copper.

In working brass or copper it will be come hard, and if hammered to any great extent will split. To prevent cracking or splitting, the piece must be heated to dull red heat and plunged in cold water; this will soften it, so it can be worked easily. Be careful not to heat brass too hot or it will fall to pieces. These pieces must be annealed frequently during the process of hammering.

Full directions for annealing copper are given in the Scientific American Supplement No. 1161.

Cast Iron.

To anneal cast iron, heat it in a slow charcoal fire to a dull red heat; then cover it over about 2 inches with fine charcoal; then cover with ashes. Let it lie until cold. Hard cast iron can be softened enough in this way to be filed and drilled.

Wrought Iron.

Chains.—Get your chain to a cherry red or bright red heat (it need not remain in the furnace or fire afterward), then bury in charcoal dust or fine ashes until thoroughly cold. Chains are generally made from "best best" iron, and are more liable to crystallization than more common iron would be, as it is purer.

Steel.

1.—More steel is injured, and sometimes spoiled, by over-annealing than in and other way. Steel overheated in annealing will shrink badly when being hardened; besides, it takes the life out of it. It should never be heated above a low cherry red, and it should be a lower heat than it is when being hardened. It should be heated slowly, and given a uniform heat all over and through the piece. This it is difficult to do in long bars and in an ordinary furnace. The best way to heat a piece of steel, either for anealing or hardening, is in red hot, pure lead. By this method it is done uniformly, and one can see the color all the time.

2.—For a small quantity, heat the steel to a cherry red in a charcoal fire, then bury it in sawdust, in an iron box, covering the sawdust with ashes. It is stay until cold. For a larger quantity, and when it is required to be very soft, pack the steel with cast-iron (lathe or planer) chips in an iron box as follows: Having at least half or three-quarters of an inch in depth of chips in the bottom of the box put in a layer of steel, then more chips to fill the spaces between the steel and also the half or three-quarters of an inch space between the sides of the box and steel, then more steel; and lastly, at least one inch in depth of chips, well rammed down on top of the steel. Heat the whole to and keep at a red heat for from two to four hours. Do not disturb the box until cold.

3.—*Water Annealing.*—a.—First heat the steel to a red heat; let it lie until nearly black hot, then throw into soapsuds. Steel treated in this way can be annealed softer than by putting it into the ashes of a forge.

b.—It is now recommended as a good method of annealing steel to let it remain in the fire until red hot, is it heats more evenly, then take it from the fire and carry it to some dark place, allowing it to cool in the air until the dull red is no longer obvious in the dark, and finally cooling it off in hot water.

BRAZING.

1.—If gas can be procured, it makes by far the best brazing heat, is clean, and in using it one has the advantage of being able to place his work to the best advantage and to be able to see exactly what he is doing during the brazing process. Gasoline forges are about half way between gas and coal forges. The greatest difficulty with most gasoline forges is that they do not give enough heat for good-sized jobs. If neither gas nor gasoline are available, then the coal forge must be used; but in doing any kind of brazing, only good clean coal can be used, and coke or charcoal if possible. For cast-iron brazing the coal must be practically free of sulphur. Malleable iron is not so difficult to braze, and almost any means of heating may be used, and an ordinary flux (borax, boric acid, or anything of that nature) will cause the brass to run over it like water.

Malleable iron, steel, or common iron brazing is usually successful but cast iron is more difficult. The principal difference in brazing cast iron is that a special flux must be used, and a greater heat and a longer time are required. The following flux is recommended: Boric acid, 1 lb.; pulverized chlorate of potash, 4 oz.; carbonate of iron, 3 oz. Mix this thoroughly, rolling out all the lumps, and then add 2 lb. of granulated yellow brass spelter. This flux must be kept perfectly dry. A big fruit jar with the top screwed on tight may be used, and only a little taken out as needed. To use this, arrange the pieces of cast iron to be brazed in such a way that they will not jar out of line during the brazing, and the break so that the brass and flux has a chance to flow down through it. Let the heat come from below, no matter what kind of forge is used. If using gas, throw the blast so that the flame will deflect upward. Heat the piece to a bright cherry red before applying the mixture. Then, using an iron rod, flattened on the end and heated red, apply the flux and brass, rubbing it along the break and working it in lightly, gradually raising the heat till the piece is nearly white. Keep applying the mixture for some time after it has begun to flow nicely, and when you are sure that the flux has flowed all through the break, shut off the fire and let it cool down slowly. Do not hurry the heat, brazing, or cooling. If you have taken care that the break was clean and free from grease in the first place, and have followed directions faithfully, you will be astonished at the strength of the brazing joint. It will not break in the same place again, but will break either some distance away or across the first fracture. You cannot tear apart a good cast-iron braze. In trying this flux for the first time, do not use too small a piece, but take a cast-iron bar, say 1 × 1 × 12 in., break in two in the middle, and experiment on that till you yet used to the right heat and the action of the flux. After thoroughly testing out this you may begin on smaller articles, but remember that on very small pieces fire-brick or clay must be built up around them in order to hold in the heat, as a small piece hasn't body enough itself to properly fuse the flux. This flux can be also used for welding and makes an unusually good compound. Any first-class druggist can supply the ingredients, and if no spelter can be obtained, chop up some soft brass rod, sheet or scrap, and mix in; but remember, do not apply flux till your iron is at least cherry red; the hotter the better, just so the iron doesn't melt. For ordinary brazing, such as bicycle frames and the like, the following flux is recommended: Boiling water, 1 pt.; borax, 1 pt. Let this dissolve thoroughly; then add 2 pt. of boric acid. No care need be taken of this flux other than to keep the dirt out of it. When using it dry, add a little water and paint the article wherever brass is wanted to flow. This should be done before heating, after heating more flux and brass is applied. Brass will follow this flux "uphill" for an inch or so. This flux, however, has no effect whatever on cast iron.

2.—Probably for some kinds of work borax will never be improved upon for a flux, but for some other varieties of brazing borax does not completely fill the bill—as, for example, when brazing work which must be filed and cannot be ground. Then the borax will leave a very hard skin, which destroys many a file before it is fully removed. For this kind of work some mechanics like to use boracic acid, putting it on with a brush or a swab. The hard skin is thinner, and comes off easier when the acid solution is used, but a writer in the *Tradesman* is of opinion that the difference lies mostly in the fact that not so much of the flux is used when the solution is employed. The usual way is to pound up a lot of lump borax in a lead-melter's ladle or the hollow of a blacksmith's sow. Some of this (usually very coarse) powder is placed on the work with a bit of flat iron. Too much borax for the purpose is necessarily used in this manner, and the excess goes to make up the hard skin which "does for" the files. When the acid is used the same effect is secured as when the solid borax is applied, but not one-tenth the amount is used, and that is applied just where it is needed. If, for any reason, the manager insists upon a solid borax being used, make that official secure a coffee mill (one of the old-fashioned cheap ones will answer perfectly) and have all the borax ground very fine. Then a little of the dust powder can be rubbed or dusted on where the joint is to be made, and the braze made without having a lot of oxide and slag piled up around the work.

Aluminum.

Aluminum bronze will braze as well as any other metal by using ¼ brass solder (copper 50%, zinc 50%), and ¾ borax.

Steel.

The following solder will braze steel, and may be found very useful in case of a valve stem or other light portion breaking with it is important that the engine should continue to work for some time longer: Silver, 19 parts; copper, 1 part; brass, 2 parts. If practicable, charcoal dust should be strewed over the melted metal of the crucible.

CASEHARDENING.

1.—A reliable method is to place the pieces to be hardened in an iron box made airtight by having all its seams covered well with fireclay, filling the box in with bone dust closely packed around the articles, or (what is better) with leather and hoofs cut into pieces about an inch in size, adding thin layers of salt in the proportion of about 4 lb. salt to 20 lb. of leather and 15 lb. of hoofs. In packing the articles in the box, be careful to so place them that when the hoofs, leather, etc., are burned away, and the pieces of iron in the box receive the weight of those above them, they will not be likely to bend from the pressure. When the articles are packed and the box ready to be closed with the lid, pour into it 1 gal. of urine to the above quantities of leather, etc.; then fasten down the lid and seal the seams outside well with clay. The box is then placed in a furnace and allowed to remain there for about twelve hours, when the articles are taken out and quickly immersed in water, care being taken to put them in the water endways to avoid warping them. Articles to be casehardened in the above manner should have pieces of sheet iron fitted in them in all parts where they are required to fit well and are difficult to bend when cold. Suppose, for instance, it is a quadrant for a link motion: fit into the slot where the die works a piece of sheet iron (say ¼ in. thick) at each end of the slot, and two other pieces at equidistant places in the slot, leaving on the pieces a protection to prevent them from falling through the slot. In packing the quadrant in the box, place it so that the sheet iron pieces will have their projections uppermost; then in taking the quadrant out of the box, handle is carefully, and the pieces of iron will remain where they were placed and prevent the quadrant from warping in cooling or while in the box, from the pressure of the pieces of work placed above it. It is obvious from what has been already said that the heavier pieces of work should be placed in the bottom of the box.

2.—*Small Articles.*—Take a length of gas pipe of from 6 to 12 in. and of suitable diameter, screw on thimble caps, and pack the screws in them with bone dust, or with equal parts of charcoal dust and unslaked lime; heat to a red for 2 hours, then chill in cold water. A charcoal or a coke fire is best; authracite will do, but bitumous coal is objectionable.

3.—Sal soda, 27 parts; lampblack, 24 parts; sodium chloride, 3 parts; black oxide manganese, 1½ parts.

4.—Take some good charcoal (from oak the best); also some marble (carbonate of lime). Mix together, the marble having been broken small. Then lay the tool or other piece to be casehardened in this compound, in a covered box, and subject it to good and continuous heat. Result: a deep penetration of the carbon into the iron, and therefore coating of steel. In other words, the outer cuticle has been converted into steel by the process of cementation.

5.—A mixture said to be very efficacious for casehardening iron consists of 16 parts of lampblack, 18 parts sal soda, 4 parts muriate of soda, 1 part black oxide of manganese.

Iron.

Prussiate of Potash Process.—1.—Crush the potash to a powder, being careful that there are no lumps left in it, then heat the iron as hot as possible without causing it to scale; and with a piece of rod iron, spoon-shaped at the end, apply the prussiate of potash to the surface of the iron, rub it with the spoon end of the rod until it fuses and runs all over the article, which must then be placed in the fire again and slightly reheated, and then plunged into water, observing the rules given for immersing steel so as not to warp the article.

2.—Powder the prussiate of potash and spread upon the surface of the piece of iron to be hardened, after the iron is heated to a bright red. It almost instantly fluxes or flows over the surface, and when the iron is cooled to a dull red it is plunged into cold water. Some prefer a mixture of prussiate of potash, 3 parts; sal ammoniac, 1 part; or prussiate, 1 part; sal ammoniac, 2 parts, and finely powdered bone dust (unburned), 2 parts. The application is the same in each case. Proper casehardening, when a deep coating of steel is desired is done by packing the article to be hardened in an iron box with horn, hoof, bone dust, shreds of leather or raw hide, or either of these, and heated to a red heat, for from 1 to 3 hours, then plunged in water.

3.—Prussiate of potash, 20 parts; saltpeter, 20 parts; sal ammoniac, 20 parts; pulverize, and mix thoroughly. Heat the case iron to a cherry heat and roll it in the above composition, taking care to touch every part of the surface. Plunge while hot in a bath containing 3 oz. prussiate of potash and 6 oz. sal ammoniac to each 1½ gal. of cold water.

HARDENING.

Copper.

1.—Mix thoroughly when in a molten condition with from 3 to 5% of manganese oxide.

2.—Copper treated as follows becomes harder and tougher than commercial hard copper: Take 2 lb. of alum and 8 oz. of arsenic, and mix well. 40 lb. of copper is to be used with this quantity of alum and arsenic. When the copper is thoroughly melted the alum and arsenic are poured in the crucible, and mixed well wit hthe melted copper. The copper is then poured, and allowed to cool gradually.

Iron.

Cast.—1.—Salt, ½ pt.; saltpeter, ¼ lb.; prussiate of potash, ⅛ lb.; cyanide of potash, ¼ lb.; soft water, 5 gal. Heat the iron to a cherry red, dip in the mixture. If not hard enough repeat the process.

2.—1 lb. of strong sulphuric acid is mixed with 1½ gal. water and 1 oz. of nitric acid. Heat the iron in a clean fire to a cherry red, and plunge into the mixture.

3.—For cooling and hardening cast iron: To 60 l. of water add 2.5 l. of vinegar, 3 kgm. of common salt and 0.25 kgm. of hydrochloric acid.

Steel.

1.—A new process of hardening steel is to coat the metal with a mixture of whiting and varnish, heat to a cherry red, and to then dip for a few seconds in acidulated water. The steel is then dipped in rape oil for a slightly longer time, and is finally laid in a cooling bath of rock oil or a mixture of water and whiting. By dipping the steel first in the water, the heat is drawn away from the outer layer, which thus becomes hard. Dipping it in the rape oil retards the cooling of the interior of the metal, and obviates the risk of cracks appearing.

2.—To 1 lb. of prussiate potash add 3 lb. common salt, 2 oz. borax, and 2 oz. cyanide potash. Place the same in a crucible and place the same over a fire; when hot put the steel in the mixture and there let it remain until hot, after which immediately plunge it in water until cool. This prevents the steel from cracking or warping, and will give perfect satisfaction.

Avoiding Cracks, Curving and Warping.—1.—Thin, flat pieces should be immersed, edge foremost, with uniform velocity. If allowed to touch the water with the board surface, they would warp.

2.—Articles considerably thicker on one side than on the other—for instance, razors—must be immersed with the thick side foremost, as otherwise the thin side would show cracks.

3.—The article is to be immersed in the hardening water as far as it has been made red hot; otherwise a crack is formed on the place of immersion.

4.—In hardening cast-iron articles tipped with steel, it must be taken into consideration that cast iron contracts more strongly than steel, and that consequently the article would curve every time. To avoid this, curve the article before hardening to the opposite side.

Cutlery.—1.—Sal ammoniac, 6 lb.; refined borax, 3 lb.; water, 4½ qt.; red wine, 6 oz.

2.—Water, 6 gal.; potash, 1½ lb.; sal ammoniac, 4½ lb.; red wine, or wine vinegar, 2¼ pt.; tartaric acid, 1½ lb.

Drill and Cutting Tools for Use on Hard Steel, Chilled Iron, Glass and Other Hard Substances.—1.—Dissolving zinc in muriatic acid to saturation. Reduce the solution by adding an equal volume of water.

For the tool use new steel or steel that has never been heated to a cherry red. Heat the tool *after it has been sharpened,* taking care not to heat it above a dull cherry red. Plunge it in the zinc chloride solution above described and hold it still until cool. Use without further sharping.

When the tool becomes dull, grind it as little as possible to sharpen. If it does not stand well after grinding, reharden.

Use the usual lubricants for drills and cutters; oil, or soap water for tempered steel; turpentine for glass, very hard steel and chilled iron.

2.—Any piece of steel wire can be made into a drill of such hardness that it will easily penetrate glass, or into an engraving tool, with which to graduate bottles, etc. In the first place, shape the wire as desired by filling, then mix 4 parts powdered rosin and 2 parts fish oil with 1 part tallow heated to the melting point. Heat the wire or other object to be hardened to dull redness, dip it into the mixture, and leave there until perfectly cold. After that it is heated again and dipped into cold water until the desired degree of hardness is obtained.

3.—Drills used for riveting glass and china are made of fragments of diamond, and these, of course, require no hardening. For steel drills harden them as jewelers do their small tools—viz., heat to a cherry red and plunge into sealing wax, quickly withdraw and insert in a fresh place, and repeat this operation until too cold to enter the wax. In using a steel drill for glass it is advantageous to keep it moistened with turps, or better still, a solution of camphor in turpentine.

Expansion of Wrought Iron and Cast Steel.—It is important in workshop manipulation to remember that if a piece of cast steel be made red hot, and quenched in cold water, it will become longer, but if the same operation be performed upon a piece of wrought iron it will become shorter.

Files.—200 parts of common salt; 10 parts crushed white glass; 75 parts of neatsfoot burned and pulverized; 25 parts of rye flour, 25 parts of rosin, 20 parts of charcoal powder, 12 parts of ferrocyanide of potassium pulverized, made into a paste with alcohol, applied to the files as a coat, which are then dried and placed in a fire. After heating introduce vertically into the hardening water.

Fluid for Hardening.—Rosin, 25 lb.; train oil, 12 lb.; lard, 5 lb.; asafetida, 1½ lb.

Glycerine for Hardening Steel.—It is stated by the *Pharmaceutische Zeitung* that soft steel placed in glycerine of 1.08 to 1.26 specific gravity, heated to from 180 to 200° C., and let remain for some time, gradually becomes hard, and that the higher the temperature of the glycerine, the harder the steel. We think that our contemporary has forgotten to state that, after remaining in the hot glycerine the stated time, the metal should be suddenly cooled off either in water or in quicksilver.

Mill Picks.—The only peculiarity in hardening mill picks is to leave the edge thick, say 1-16 in. Harden at the lowest heat that the particular kind of steel will take, in clean water at about 60°. Draw temper as little as possible, which may be ascertained by trial at a straw color to begin with. Do not draw temper with the same heat used for hardening. The pick after hardening should be tried with an old fine file, which by a little experience will tell you if the hardening is even. Then grind and heat from the center for color drawing. If you use low grade steel of first-rate quality, the color temper may be dispensed with. The greatest difficulty is caused by burning the corners in forging or in heating to harden. Therefore use a dull charcoal fire if possible with light blast. Blast often ruins the finest steel.

Outside Hardening.—The following is said to keep the inside soft while the outside remains hard: Borax and potassium nitrate, 3 parts of each; yellow prussiate of potash, 10 parts; lead acetate, 1 part. Grind the materials up fine and mix them thoroughly. When the steel is heated to red heat sprinkle over some of the powder, return to the fire until the proper color is reached, then cool in rain water.

Petroleum.—According to B. Morgossy, the articles to be hardened are first heated in a charcoal fire, and, after thoroughly rubbing with ordinary washing soap, heated to a cherry red. In this condition they are quickly plunged into petroleum; ignition of the petroleum need not be feared, but, of course, an open flame must not be near at hand. Articles harndened according to this method show no cracks, do not warp in the least, and after hardening remain nearly white, so that they can be blued without previous rubbing with emery.

Piano Strings.—The steel wire must be heated to redness and cooled off; then immersed in a freshly melted metal bath of 40 parts lead, 12 parts zinc, 26 parts antimony, 21 parts tin, and 1 part bismuth. When taken out, sprinkle or pour cold water over it.

Sealing Wax, Hardening in.—Heat the steel article to a white heat and plunge into the sealing wax. After an instant withdraw and insert in a new part of the wax. Repeat the operation until the steel becomes so cold that it refuses to enter the sealing wax.

Screws.—Get some charcoal and reduce it very fine; now take 1 part of prussiate of potash and 2 parts common table salt, powder these and dissolve them in hot water, just enough to keep them insolution: wet the charcoal into a paste with it, and imbed your articles in it in a sheet-iron pan; place in a slow fire and subject them to a nice red heat, and if very small you will not want the hardening to penetrate too deep. Five minutes will do, but the longer they are subjected to the process the harder they will be and the deeper. Plunge them into cold water, box and all. By this means you will have them clean and hard and will not lose any in the fire.

Small Objects.—1.—Put soap on the pieces before heating. Use muriatic acid, 1 part; water, 2 parts; for cleaning the pieces when made black by hardening.

2.—In order to harden small objects that must not be distorted and in which a uniform hardness is a primary consideration, make a small iron box, with a handle, of the size of the object; a suitable tin box can also be used. This is then filled with pulverized charcoal, in which the objects, as near to the top as possible, and where there are several articles with a space between them, are placed. In order to attain the proper heat, a small piece of steel is laid directly upon the crushed coal. When the steel shows the desired deep-red heat, the cooling may be effected in lukewarm water. The annealing is best effected in an annealing furnace.

Springs.—Above all, a variety of steel must be chosen which is suitable for the production of springs, a very tough quality with about 0.8% of carbon being probably the best. Any steel works of good reputation would no doubt recommend a certain kind of steel. In shaping a spring, forging and hammering should be avoided if possible. In forging an uneven treatment can scarcely be avoided; one portion is worked more than the other, causing tensions which, especially in springs, must be guarded against. It is most advantageous if a material of the thickness and shape of the spring can be obtained, which, by bending and pressing through, is shaped into the desired spring. Since this also entails a slight tension, a careful annealing is advisable, so as to prevent cracking or distorting in hardening. The annealing is best conducted with exclusion of the air, by placing the springs in a sheet-iron box provided with a cover, smearing all the joints well up with loam. The heating may be done in a muffled furnace; the box, with contents, is, not too slowly, heated to cherry red, and then allowed to cool gradually, together with the stove. The springs must only be taken out when they have cooled off enough that they will give no hissing sound when touched by water. In order to uniformly heat the springs for hardening, a muffle furnace is likewise employed, wherein they are heated to cherry heat. For cooling liquid a mixture of oil, tallow and petroleum is employed. A mass consisting of fish oil, tallow and wax also renders good service, but one should see to it that there is a sufficient quantity of these cooling liquids so that the springs may be moved about, same as when cooled in water, without causing an appreciable increase in the temperature of the liquid. In most cases too small a quantity of the liquid is responsible for the many failures in hardening. When the springs have cooled in the hardening liquid they are taken out, dried off superficially, and the oil still adhering is burned off over a charcoal fire. This enables one to moderate the temper according to the duration of the burning off and to produce the desired elasticity. An even heating being of great importance in hardening springs, the electric current has of late been successfully employed for this purpose.

Schaefer's Fluid.—This fluid is composed of rosins, linseed oil, glycerine and powdered wood charcoal. Heat and mix thoroughly. Heat the steel to a fine, bright cherry red and drop in the fluid and let it remain until cold. Burnt cast steel regains its properties when hardened in this fluid.

Straightening Hardened Steel. — In hardening and tempering tools they sometimes spring, to the great annoyance of the workmen, and not seldom the tool is reheated and rehardened. In most cases this may be avoided. To straighten a piece of steel already heated and tempered, heat it lightly—not enough to draw the temper—and it may be straightened by blows from a hammer, if the character of the tool will admit of such treatment, or, as in case of a tap, it may be straightened by a heavy mallet on a hardwood block. Although the steel, when cold, would break like glass with this treatment, when slightly warmed it will yield to moderately heavy blows uninjured.

Thin Steel.—1.—Beef suet, 3 lbs.; train oil, 1½ gal.; wax, 6¾ oz.; add 1½ lb. rosin.

2.—Spermaceti oil, 47½ parts; melted tallow, 5 parts; neatsfoot oil, 2¼ parts; pitch, ¼ part; rosin, ¾ part.

Tools.—Die Zeitschrift fur Maschinenbau und Schlosscrei is authority for the following process: Powedered stag's hoof, 500 parts; Peruvian bark, 500 parts; cooking salt, 250 parts; refined saltpeter, 150 parts; potassium cyanide, 150 parts; all powdered well, mixed and made into a paste with 1,000 parts of black soap. The tools are made red hot, the powder is applied, and the tools are next hardened. For tempering the following lead baths are recommended: Tin 4 parts, lead 7 parts; tin 4 parts, lead 8 parts; tin 4 parts, lead 14 parts; tin 4 parts, lead 19 parts; tin 4 parts, lead 48 parts; tin 2 parts, lead 50 parts.

Watch Drills.—A simple way of hardening small watch drills: Heat the tools in the flame of a candle and then plunge suddenly in the candle grease. This is done on account of the drills being so small that they will not retain their heat sufficiently long to enable the operator to remove them from the source of heat to a vessel containing water used for hardening.

Zinc.—From 1½ to 3½ oz. of sal ammoniac are added to the molten metal. This yields a metal which can be easily worked with tools.

SOFTENING STEEL.

1.—Place a quantity of newly burnt lime in a damp place, where it will fall in the form of flour; put it in an iron box. Heat the articles to dull red; clean off all scale, and put in lime, and completely cover with lime; cover box over with iron lid and have until cold. The more lime and larger the box the better. Keep airtight if possible.

2.—One tablespoonful each of hydrochloric acid and saltpeter to 1 gal. of water. Heat the steel and cool in it; then heat to soften by letting cool. Cast steel thus treated will weld with sand.

TEMPERING.

Steel.

1.—In judging the proper temperature and correspondig hardness, the following table serves admirably It is often difficult to heat a piece of steel uniformly, consequently molten metallic mixtures are employed, chiefly made up of tin and lead; the bright hardened steel is kept in these molten mixtures until it has assumed the temperature of the bath. The following tabulated from exhibits the composition of the metallic baths which have been found to be the best for tempering cutlery:

	Composition of metallic mixtures. Lead.	Tin.	Melting point.	Colors.
Lancets	7	4	220°	Hardly pale yellow
Razors	8	4	228°	Pale yellow to straw yellow
Penknives	8½	4	232°	Straw yellow
Pairs of scissors	14	4	254°	Brown
Clasp knives, joiners' and carpenters' tools	19	4	265°	Purplish colored.
Swords, cutlasses, watch springs	48	4	288°	Bright blue
Stilettos, boring tools and fine saws	50	2	292°	Deep blue
Ordinary saws	Boil'g linseed oil		316°	Blackish blue

2.—(a) Use animal charcoal produced by charring horn, 24 parts; horn filings, 4 parts; glue, 6 parts; potassium nitrate, 9.5 parts; common salt, 55 parts. (b) Potassium bicyanide, 1 part; purified saltpeter, 1 part; burnt and powdered cattle hoofs, 1 part; gum arabic, 1-30 part;

aloes, 1-30 part; common salt, 0.5 part. Mix a and b well together after being well pulverized, strew this upon steel when red hot and upon wrought iron when white hot, and allow it to burn in, after which cool as usual.

3.—Cast Steel.—Dissolve a small quantity of sal ammoniac in water, make the metal red, drop it into the mixture for a second or two, and take it out, leaving enough heat in the metal to draw it back a bit. If left till cold, the steel will be a great deal too hard.

Axes.—The poll should be heated in a charcoal fire until it is little more than a cherry red. Then change ends and heat the bit to a cherry red. Cool the bit only in cold salt water. Immerse in the water at once, otherwise there may be a fire crack in it that will spoil it.

Scout with bricks; put the poll in the fire endways. The temper should run to a blue. Do not use a blast.

Burglar and Drill Proof Diamond Chill.—Take 1 gal. urine and add to it 1 oz. borax and 1 oz. salt.

Cold Chisels.—Heat the chisel at a low heat, so as not to raise a scale. Dip in a brine of clear salt and water. About 1 qt. of salt to 10 qt. of water is the right proportion. Leave heat enough in the tool to run the temper down to a required hardness, which is shown by the pigeon blue color. Take care to make the chisel stout enough that it won't spring in the using.

Drill.—1.—A drill heated to a low red, and plunged in a strong solution of chloride of zinc, will drill glass.

2.—Heat the drill and rub in cyanide of potassium. The drill should be hot enough to melt the potassium. Heat again to a dark cherry red, and cool it in a very strong brine made with warm, soft water. Do not draw the temper. The drill will look white, but be hard and tough.

3.—The drill should be heated to a cherry red in a charcoal fire, then plunged in cold water to which a handful of salt is added. Make the drill bright. Draw to a light straw color.

Gravers.—Instruments larger than drill may be tempered in mercury the same as above, but lead may be used as a substitute for mercury. The lead is lessened about half an inch, and the instrument, made light red hot, is pressed into the cut. The melted lead than surrounds it.

Gun Springs.—To temper gun springs, heat them evenly to a low red heat in a charcoal fire, and quench them in water with the cold chill off, keeping them immersed until reduced to the temperature of the water. Place an iron pan containing lard oil and tallow, in about equal quantities, over a fire, and place the springs therein, and heat the pan until its contents take fire; then hold the springs in the flames, turning them over and over and dipping them occasionally in the oil to keep them blazing; when the oil adhering to them blazes freely when they are removed from the flames, place them aside to cool off.

Knife Blades.—Be careful about heating, otherwise the blade will be warped out of shape. When the blade is heated evenly, plunge perpendicularly in a bath of raw linseed oil. The temper should be drawn on a hot iron. The blades may be heated and hardened between two straight pieces of iron.

Liquid for Tempering.—1.—Saltpeter, 1 oz.; alum, pulverized, 2 teaspoonfuls; salt, 1 teacup; soft water, 2 gal.; never heat over a cherry red nor draw any temper.

2.—Water, 7½ gal.; saltpeter, 5 oz.; sal ammoniac, 5 oz.; alum, 5 oz. Draw to temper.

3.—Water, 2 gal.; saltpeter, 2 oz.; alum, 2 oz.; sal ammoniac (pulverized), 1 oz.; salt, 1½ lb. Heat to a cherry red, plunge in, draw no temper.

4.—Water, 2 gal.; saltpeter, ½ oz. pulverized borax, ½ oz.; white vitriol, 1 oz.; salt, 1½ pt.

5.—Put ½ oz. of corrosive sublimate in 3 qt. of soft water and add 1 handful of common salt. Dissolve, and it is ready for use. This gives toughness and hardness of steel. It is a dangerous poison.

6.—Alum, 1 oz.; saltpeter, 1 oz.; sal ammoniac, 1 oz.; salt, ¾ lb.; soft water, 1½ gal. Draw no temper.

7.—Saltpeter, 1 av.oz.; borax, 1 av.oz.; sal ammoniac, ½ av.oz.; common salt, 12 av.oz.; water, 1 gal. Mix and dissolve.

Mill Chisels, Tempering for.—Prepare a mixture of water, 1½ gal.; ammonia, 1½ oz.; white vitriol, 1½ oz.; sal ammoniac, 1½ oz.; spirits of niter, 1½ oz.; alum, ½ oz.; salt, 3 oz. and 1 handful horse-hoof parings. Keep in a jar tightly corked. The pick should be heated to a dark cherry red and cooled in this liquid. Do not draw the temper.

Screw Gages.—Heat in melted lead; harden in cold water or brine pickle; polish bright; draw to color (straw) in hot sand. If the steel is homogeneous, there will be no change in size.

Springs, To Temper.—1.—Tempering of coiled springs requires much judgment, based upon experience with the particular kind of spring that you wish to temper. A coiled spring does not give the faintest idea of its form, size, length, thickness, kind of steel, or whether it is a clock spring or car spring, all of which must be considered in the method of treatment. As a general rule, springs that are slender and liable to lose shape in a common fire should be heated in an oven or muffle and hardened in water or oil. The temper should be drawn in boiling linseed oil. Springs that have stiffness, like car springs, may be heated in a covered forge fire to good advantage and hardened in lard oil. The temper can be drawn by burning off.

2.—Heat to an even red heat, rather low, to prevent cracking; quench in lukewarm water. Place in ladle with enough tallow to cover it; heat until tallow burns with a large flame extending beyond ladle, then set the ladle aside and allow it to cool.

3.—Revolver Springs.—Heat the spring to a cherry red and plunge in linseed oil. To draw the temper to the desired degree, hold the spring over the fire, and allow the oil to burn away, take away from the fire, put on more oil, and let it burn away. Burn the oil off three times and plunge in the oil again. The spring is then ready for use. Do not overheat the steel. Test the temper frequently with a file.

Taps.—Bear in mind that a tap is simply a series of cutters on a bar; hence the cutting parts must be uniformly hard enough to cut, and the base soft as possible to insure durability. This can be best accomplished by dipping at as low a heat as possible and making the outside hard, while the inside will be comparatively soft when rubbed off ready for tempering. Heat a heavy ring (a broken pulley hub is as good as anything), which have on side of your fire for use while hardening taps, and also a heavy pair of tongs, made hot in the same way. Take the lever end of the tap with the hot tongs, and insert the tap in the center of the hot ring, but do not let it touch the sides. It is better to keep turning it round. If the temper draws too fast, where held by the tongs, cool it off, move backward and forward until the right color is attained. This, too, depends on quality of steel and the size and make of the tap, and lastly the purpose for which it is intended.

WELDING

Directions.

The great secret of weldnig is to have a clean fire, then heat the iron and "strike while the iron is hot." Make the fire of blacksmiths' coal which has been caked (coke). If the work is small have only a little fire. As the weld requires considerable pounding, plenty of stock should be left by using generous laps. Be sure the laps fit well before welding. When the iron gets from a red to a white heat sand the iron without removing from the fire and watch the iron carefully. When it sparks freely and has a glazed appearance, remove from the fire, lay quickly, after a shake to remove the oxide, and pound the lap well until the iron becomes too cold to work.

Composition for.—1.—To 20 parts of iron filings add 10 parts of borax and 1½ part sal ammoniac and 1 part of balsam of copaiba or other resinous oil. Mix well, heated and pulverized. The surfaces to be united are powdered with this mixture; after which place the article in the fire and let it come to a cherry-red heat; when the composition melts, take the portions to be welded from the fire and join together. This composition is used in Germany with great success.

2.—Another composition for welding consists of 30 parts of borax, 4 parts of sal ammoniac and 4 parts of cyanide of potash. Dissolve in water and then evaporate the water at a low temperature.

Copper.—(Rust.).—Prepare a mixture of 358 parts soda phosphate, 224 parts boracic acid; apply the powder when the metal is at a dull red heat; it is then brought to a cherry red and at once hammered. As the metal is apt to soften when exposed to a high degree of heat, a wooden hammer is recommended. Remove all carbonaceous matter from the surfaces to be joined, as the success of the operation depends on the formation of a fusible phosphate of copper. The phosphate of copper dissolves a thin film of oxide on the surfaces of the metal, keeping them clean and in condition to weld.

Fluxes.—1.—A welding material composed of 25 parts of borax, a paper or metallic support and 60 parts metallic filings of the same nature as the metals to be welded, and made by first melting the borax; second, immersing the support in the fused borax; third, smoothing the same by passing it through pressure rollers; fourth, sprinkling its two faces with the metal filings: fifth, heating the sheet in an oven; sixth, passing through pressure rollers.

2.—A welding material composed of borax and metallic filings of the same nature as the metals to be welded, mixed with the fused borax, and in the proportions substantially as set forth, and then rolled out into sheets of about 1-16 in. thick.

3.—The welding sheets coated with a layer of gum lac or other appropriate varnish.

4.—The following compound has been frequently offered as a trade secret: Take copperas, 2 oz.: saltpeter, 1 oz.; common salt, 6 oz.; black oxide of manganese, 1 oz.; prussiate of potash, 1 oz. Pulverize these ingredient sand mix with them 3 lbs. nice welding sand.

Lead.—An ingenious method of welding lead has been devised by M. Blondel. The surfaces to be joined are carefully cleaned and between them is placed a thin layer of lead amalgam. On passing an ordinary soldering iron along the line of junction, the mercury of the amalgam is vaporized, and the lead, set free in an exceedingly finely divided state, fuses and unites the two surfaces together.

Powder.—Belgian Welding Powder.—1.—Iron filings, 800 parts; borax, 400 parts; balsam of copaiba or other resinous oil, 40 parts; sal ammoniac, 60 parts. Mix, heat and pulverize finely. Powder the surfaces to be welded, bring to a cherry-red heat, at which the powder melts; take from the fire and join.

2.—Calcine and pulverize together 50 parts iron or steel filings, 5 parts sal ammoniac, 3 parts borax, 2½ parts balsam copaiba. Heat one of the pieces to be welded red carefully clean off scale, spread the powder upon it; apply the other piece at a white heat and weld with a hammer. Used for welding iron and steel, or both, together.

Iron and Steel Together.—1.—To weld cast steel with cast steel or with iron, a welding powder has to be made use of, if a secure seam is desired, since cast steel cannot stand sparkling heat. An excellent welding powder is produced as follows: In an unglazed iron vessel or crucible fuse borax in an annealing furnace until the liquid appears entirely dark green. Test the molten mass by immersing a wire or piece of iron, to which a sample will cling. First the molten mass is pale yellow, but it gradually turns darker. As soon as the sample taken with the iron rod, which immediately cools into a hard mass, acquires a dark green or black color, the moment has arrived to remove the vessel from the fire in order to pour the contents into another cold, but dry, receptacle. After complete cooling, the glass-like dark mass is crushed in a mortar into a coarse powder. The powder is pale greenish yellow, and is now mixed with an equal volume of steel filings. In storing the welding powder it must occupy a dry place to prevent the filings from rusting.

2.—Heat the steel to cherry red (after it is shaped to correspond to the surface of the cast iron to which it is to be joined). Apply borax to the surfaces to be welded. Heat the parts to a welding heat. Apply strong pressure, without immersing, which will securely weld the steel and iron.

3.—Take copperas, 2 oz.; saltpeter, 1 oz.; common salt, 6 oz.; black oxide of manganese, 1 oz.; prussiate of potash, 1 oz.: pulverize and mix with welding sand, 3 lbs. Use it in the same way as you would sand.

4.—Ten parts borax, 1 part sal ammoniac; pulverize together thoroughly, with which sprinkle the parts to be welding.

5.—To make composition used in welding cast steel, take of borax 10 parts; sal ammoniac, 1 part; grind or pound roughly together; then fuse in a metal pot over a clear fire, continuing the heat until all spume has disappeared from the surface. When the liquid appears clear, the composition is ready to be poured out to cool and concrete. To prepare it for use it is ground to a fine powder. The steel to be welded is raised to a bright yellow heat, and then dipped into this welding powder; it is then placed in the fire again, and when it attains the same heat as before it is ready to be placed under the hammer.

6.—A mass of ingredients is sold for the purpose of welding cast steel, but the simplest and best method is, according to the *Revue Industrielle*, the one employed by Fiala, of Prague, Bohemia. He uses pulverized white marble for the purpose. The two pieces to be welded together are heated, and, after rolling in marble dust, are promptly joined together and subjected to a good hammering.

7.—Welding Cast Steel Without Borax.—Copperas, 4 parts; saltpeter, 2 parts; prussiate of potash, 2 parts; black oxide of magnesia, 2 parts; common salt, 12 parts; all pulverized. Mix with good welding sand, 48 parts, and use precisely the same as you would said.

8.—Another powder which is valuable for the same purpose consists of borax, 2 parts; wrought-iron filings, free from rust, 2 parts; sal ammoniac, 1 part. These pulverized parts are moistened with copaiba balsam and made into a paste, then slowly dried over a fire and again powdered. The application is the same as above.

9.—Powder to weld wrought iron at

pale-red heat with wrought iron: Borax 1 part (by weight); sal ammoniac, ½ part; water, ½ part. These ingredients are boiled with constant stirring until the mass is stiff; then it is allowed to harden over the fire. Upon cooling the mass is rubbed up into a powder and mixed with one-third wrought-iron filings free from rust. When the iron has reached red heat this powder is sprinkled on the parts to be welded, and after it has liquefied a few blows are sufficient to unite the pieces.

10.—Welding powder to weld steel on wrought iron at pale-red heat: **Borax, 3 parts; potassium cyanide, 2 parts; Berlin blue, 1-100 part.** These substances are powdered well moistened with water; next they are boiled with constant stirring until stiff; then dry over a fire. Upon cooling the mass is finely pulverized and mixed with 1 part of wrought-iron filings free from rust. The powder is sprinkled repeatedly upon the hot pieces, and after it has burned in the welding is taken in hand.

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PHARMACEUTICS